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APPLICATION OF THE QUANTUM LEARNING MODEL ASSISTED BY GEOGEBRA TO SUPPORT STUDENT'S CONCEPT UNDERSTANDING ABILITY

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Abstract. Understanding concepts is very important in learning mathematics because the material in mathematics learning is interconnected between one material and another. To provide understanding of concepts, student-centered learning is needed. One student-centered learning model is the quantum learning model assisted by geogebra to visualize the material provided with the aim of supporting students' understanding of concepts. The aim of this research is to describe students' ability to understand mathematical concepts after applying the geogebra-assisted quantum learning model to cube and block material. This type of research is descriptive quantitative with a posttest only research design. The subjects in this research were students in class VIII.3 of SMP Ikhlasiyah Palembang. Data collection techniques use tests of ability to understand mathematical concepts and observation of teacher and student activities to see the application of the quantum learning model. The test results show that students' ability to understand mathematical concepts is in the good category with an average score of 80.02 which is measured based on indicators of understanding mathematical concepts and from observing teacher and student activities with an average teacher activity score of 93.05%. and 94.38% of student activity shows that the application of the quantum learning model is implemented very well in the learning process.

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INTRODUCTION

Understanding concepts is crucial to learning mathematics (Diana, Marethi, & Pamungkas, 2020). This is because the material in mathematics learning is interconnected between one material and another structured material (Lestari & Andriani, 2019). Students cannot understand mathematics material if they have not understood the previous material as a prerequisite for the material they will study (Novitasari, 2016). If students do not understand mathematical concepts, it will be very fatal because understanding concepts is the basis for thinking principles and theories (Hendrayana, 2017).

Based on Minister of Education and Culture Regulation no. 36 of 2018, one of the goals of learning mathematics in schools is that students can understand mathematical concepts, explain the relationship between concepts, and apply concepts or algorithms flexibly, accurately, efficiently and precisely in solving problems. In mathematics learning, understanding concepts is a mathematical ability that students must have, so that with this understanding students can better understand the concepts of mathematics subject matter (Febriani, Widada, & Herawaty, 2019). This was also stated by one of the international mathematics education organizations through the National Council of Teachers of Mathematics that the aspect included in the ability to think mathematically is the ability to understand concepts (Gorard et al., 2015; NCTM, 1988).

Lestari & Andriani (2019) stated that the ability to understand the concepts of MTS Al-Hidayah Singingi Hilir students is still relatively low, as can be seen from the large number of students who have not been able to find out what is the problem in the problem, most students cannot solve questions that are different from the examples that have been given, some students

have not been able to explain returning about the concepts of learning material that have been studied, and some students only copy their friends' answers without understanding the questions given. Another fact from the results of research conducted by Hendrayana (2017) states that junior high school students' ability to understand mathematical concepts still do not understand the concepts as expected, students are still confused when faced with the problem of finding the area of a parallelogram, then they do not memorize the formula for finding its area.

Febriani et al. (2019) stated that there are still many students who experience difficulties in understanding the concept of mathematics learning in class. The next fact was conveyed by Diana et al. (2020) that the results of the TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme Internationale for Student Assessment) studies showed the low ability of students in Indonesia to master conceptual knowledge and solving problems. Nonroutine. This is in line with research conducted by Jeheman et al. (2019) which states that students' understanding of mathematical concepts is still low among students at both primary and secondary levels.

The causes of students' low ability to understand mathematical concepts are caused by several factors, including the inappropriate learning model applied in the learning process (Diana et al., 2020). Apart from that, the learning model used in the learning process is not student-centered. Then another cause is the lack of variation in choosing learning media in mathematics learning (Novitasari, 2016). Furthermore, according to (Febriani et al., 2019) mathematics learning in secondary schools still focuses a lot on theory and is not connected to the context of everyday life so it is not able to make students happy and interested in learning mathematics. This was also expressed by Brinus et al. (2019) who stated that the learning that was applied made students passive where students just sat quietly, listened to the teacher's explanation, then rewrote what the teacher wrote down on the blackboard and students also had difficulty to understand the concepts being studied, thus making students' understanding of mathematical concepts shallow.

To support students' ability to understand concepts, efforts are needed to use a learning model that makes students active, creative, skilled, work together, and have fun, namely the quantum learning model. The quantum learning model is student-centered and has clear steps that are easy to apply in classroom learning which aims to increase students' understanding of concepts (Mubaid et al., 2019). The Quantum learning model has steps that consist of Grow, Experience, Name, Demonstrate, Repeat, and Celebrate (Putri, Suandhi, & Putra, 2017; Yahya, 2017). In the "Experience" and "Demonstrate" sections, a tool is needed that can apply the learning model, so that students can express what they have learned, especially in geometry material. A suitable tool is the Geogebra application.

Geogebra is a computer program (software) designed for learning mathematics, especially geometry (Herman et al., 2023). This program allows for visualization of complex geometric concepts and helps improve students' understanding of material concepts. The use of GeoGebra helps students solve problems in everyday life and with the environmental conditions in which they live. This software functions as a learning medium that provides students with experience in interacting with geometric concepts. Through varied and attractive displays and ease in describing geometric shapes, it is hoped that it can increase interest, creativity and learning effectiveness. This program can be used to increase students' understanding of the concepts they have studied or as a means to introduce or construct new objects (Gusmira & Matondang, 2016). Based on the description and relevant research that has been presented, the aim of this research is to describe students' ability to understand mathematical concepts after applying the GeoGebra-assisted quantum learning model to cube and block material.

RESEARCH METHODS

This type of research is quantitative descriptive. The subjects in this research were 20 eighth-grade students at SMP Ikhlasiyah Palembang. The instruments in this research are observations of teacher and student activities to see the implementation of the learning model and test instruments to measure students' ability to understand mathematical concepts. The

learning process uses the quantum learning model steps, namely Grow, Experience, Name, Demonstrate, Repeat and Celebrate. Learning activities were carried out over 3 meetings and 1 test of the ability to understand mathematical concepts.

The data collection techniques used in this research were tests and observation of teacher and student activities. The technique used to obtain data on students' ability to understand mathematical concepts after learning using the quantum learning model. The type of test used is a written test in the form of an essay (description) with 5 questions and adjusted to indicators of understanding mathematical concepts. Indicators of understanding of concepts consist of: 1) re-expressing a concept; 2) classifying objects according to certain properties; 3) giving examples and not examples of a concept; 4) presenting concepts in various forms of mathematical representation, developing necessary conditions and adequate conditions for a concept; 5) use, use and selecting certain procedures or operations; and 6) applying concepts or problem-solving algorithms. Furthermore, to see the implementation of the quantum learning model, teacher and student activity observation sheets in the form of checklists are used at each meeting in learning activities.

Data analysis in this research is quantitative descriptive data analysis to describe data in the form of data classification based on the results of posttest scores and the results of observing teacher and student activities. The student's final score obtained is calculated using the Formula 1 below (Sudjana, 2022).

$$\text{Final score} = \frac{\text{Total score obtaine}}{\text{Maximum total score}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Next, the test scores and observations are converted into categories to determine the test results of students' conceptual understanding abilities and see the results of implementing the quantum learning model in learning. The categories of test scores and observations are presented in Table 1.

Table 1. Value Conversion Categories

Mark	Category
86-100	Very good
71-85.99	Good
56-70.99	Enough
41-55.99	Not enough
≤40.99	Very less

(Modified from Arikunto, 2021)

Data obtained from the test were analyzed using descriptive statistics and calculated in the form of quantitative calculations. Then the results of the observation sheet were analyzed by looking at the frequency and calculating the percentage of each activity item to obtain an average value for each activity.

RESULTS AND DISCUSSION

The research was carried out by applying a quantum learning model using GeoGebra. Learning meetings were held 6 times with cubes and blocks as material. Each meeting follows the steps of the quantum learning model, namely Grow, Experience, Name, Demonstrate, Repeat, and Celebrate. At the last meeting, students were given test questions to measure students' ability to understand concepts based on indicators, namely 1) re-expressing a concept; 2) classifying objects according to certain properties; 3) giving examples and not examples of a concept; 4) presenting concepts in various forms of mathematical representation, developing necessary conditions and adequate conditions for a concept; 5) use, use and select certain procedures or operations; and 6) applying concepts or problem-solving algorithms.

Based on data analysis regarding the application of the quantum learning model to support students' ability to understand concepts, the results of the students' scores after implementing the quantum learning model are presented in Table 2.

Table 2. Student Scores

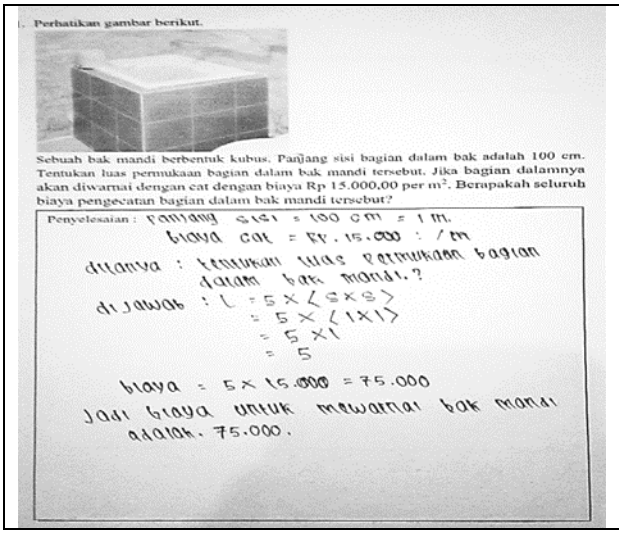
No.	Initial Name	Score	No.	Initial Name	Score
1	US	56.67	11	N K	85,00
2	AYP	71.67	12	N R	81,67
3	AN	70.00	13	P R	88,33
4	A A	83.33	14	P A	85,00
5	ICE	78,33	15	P D A	88,33
6	H M	60,00	16	R J	76.67
7	I S	75,00	17	RL	86.67
8	I N E G C	80,00	18	S.A	76.67
9	M S	85,33	19	SW	86.67
10	M I	76,67	20	WW	60.00
	Amount	1600.35			
	Average	80.02			

Data obtained from test results are classified based on the categories presented in descriptive statistics in Table 3.

Table 3. Recapitulation of Student Test Scores

Score	Frequency	Percentage	Category
86-100	4	20%	Very good
71-85.99	12	60%	Good
56-70.99	4	20%	Enough
41-55.99	0	0%	Not enough
≤40.99	0	0%	Very less

From the test data, it shows that there are 4 students who obtained the very good understanding ability category with a percentage of 20%, for the good understanding ability category there are 12 students with a percentage of 60%, and for the fair understanding ability category, there are 4 students with a percentage of 20%. One of the student's answers can be seen in Figure 1.



Translation:
A cube-shaped bathtub. The length of the inner side of the tub is 100 cm. Determine the interior surface area of the tub. The inside will be colored with paint at a cost of IDR 15,000/m^2. How much does it cost to paint the inside of the bathtub?
Solution:
Side length = 100 cm = 1 m
Paint costs = IDR 15,000/m
Asked: Determine the inner surface area of the bathtub?
Answer:
L = 5 x (s x s)
= 5 x (1 x 1)
= 5 x 1
= 5
Cost = 5 x 15,000 = 75,000
So the cost to color the bathtub is 75,000.

Figure 1. Student Answer

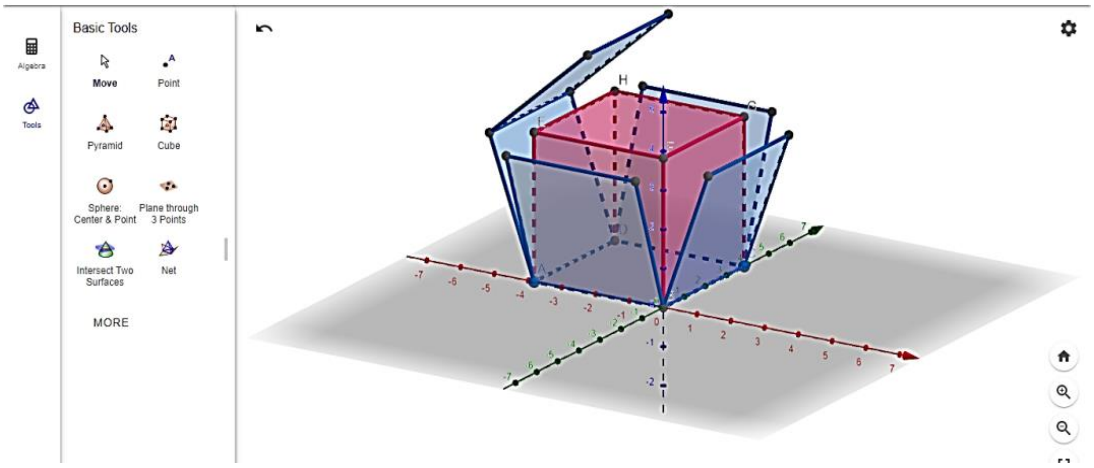
In Figure 1, it appears that students can re-declare a concept seen from students can state that to calculate the cost of paint needed, it is necessary to find the surface area, students also meet indicators of classifying objects according to certain properties seen from students can classify that the surface area sought is the surface area of the cube without a lid so that students multiply with 5 sides, students also meet indicators of giving examples and not examples of a concept, presenting concepts in various forms of mathematical representation, developing necessary conditions and sufficient conditions for a concept, students can use, use, and select certain procedures or operations, and students can apply the concept or algorithm of problem-

solving that it appears that students can solve the problem well so that they can conclude appropriately.

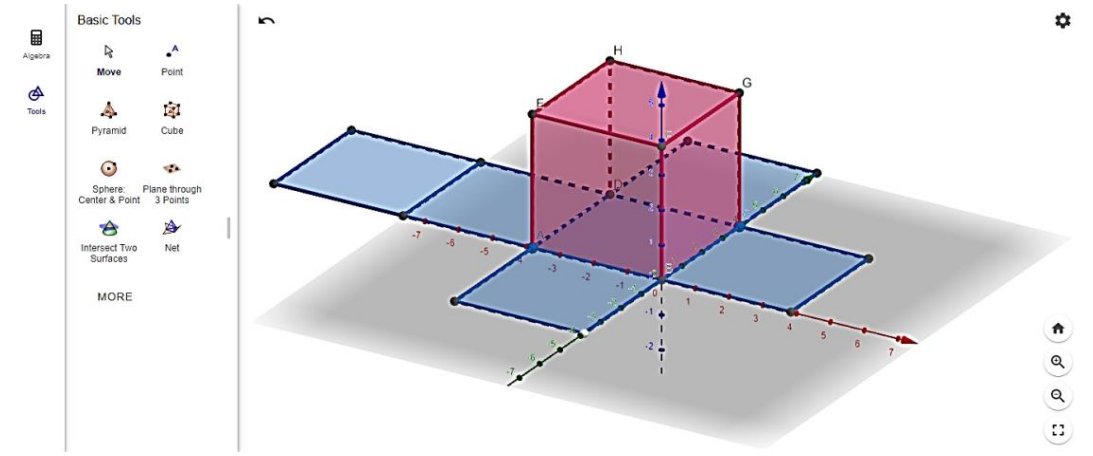
This shows that the quantum learning model can stimulate students to understand concepts. Quantum learning model to support students' ability to understand mathematical concepts better. This is because the quantum learning model has steps that can help students develop and improve their ability to understand mathematical concepts (Arif et al., 2023; Dewi et al., 2018; Yaqin, 2022). As previously explained, the quantum learning model consists of 6 steps, namely Grow, Experience, Name, Demonstrate, Repeat, and Celebrate.

Grow Step, in this step, the teacher first pays attention to the state of the student's learning environment in the classroom by providing a comfortable and enjoyable environment for students because the quantum learning model prioritizes the student's learning environment. Then the teacher gives questions in the form of pictures about objects in the form of cubes and blocks on Power Point slides to students before starting learning so that they can stimulate students' thinking about the material to be studied and find out the benefits of studying the material, especially cube and block material, and by being given modeling in the form of pictures, students will find it easier to understand the question.

Natural Steps, namely the teacher asks students to say what images they see from the geogebra slide show displayed by the teacher. This aims to make students experience problems or understand the meaning of the picture. The GeoGebra display explained by the teacher to students is shown in Figure 2.



(a)



(b)

Figure 2. Cube Material displayed in Geogebra

The next step is Name, in this step the teacher asks students to mention things that are in their minds about the concepts of the material that will be discussed with the aim of so that

students can understand the concepts of the material that will be studied. If students understand these concepts as a prerequisite for learning, then learning will be easier to understand and easier to complete.

In the next step, namely, Demonstrate, the teacher asks students to form several study groups. Then the teacher gives the student worksheet and the students work on the student worksheet. If students have completed the student worksheet, students must present the results of their answers in front of the class. This is done to make it easier for students to learn by paying attention to students who are presenting their answers in front of the class, and correcting their answers if there is a misunderstanding of the material during the lesson. The next step is Repeat, the teacher reviews the difficulties experienced by students during the learning process and in completing the student worksheet. Next, the teacher guides students and provides direction and solutions to these problems. Then the teacher asks students to conclude today's learning material. Demonstrating and repeating steps makes students' memories very clear and their listening power is strong in understanding concepts because students participate with each other in coming to the front of the class, and are not shy about expressing their opinions.

The final step is to Celebrate, this final step is a step that must be taken. Where in this step, the teacher gives appreciation to the group that best presented the student worksheet by giving a prize and giving applause to the group. This celebrating step can make students compete to show their understanding and create pleasure in students.

The results of this research are in line with the results of research conducted by Roza (2019) showing that the understanding of mathematical concepts of students who learn using the quantum learning model is better than the understanding of mathematical concepts of students who learn using conventional learning models. Similar research results also come from the results of research conducted by Fitri & Aminah (2020) that students' ability to understand mathematical concepts taught using the quantum learning model is better than using the conventional learning model.

The Quantum Learning steps which include the Grow, Experience, Name, Demonstrate, Repeat, and Celebrate steps are related to understanding the concept, namely in the Natural step, students experience directly or concretely the material being taught so that students will gain a learning experience by discovering the concept. This is in line with the opinion of Dewi & Susanto (2018) which states that in learning techniques providing direct experience will improve and facilitate students' understanding of the learning content. The previous experience that students have will be meaningful for teachers in teaching related concepts. Then in the Namai step, students are guided to draw conclusions based on the information, facts, or formulas found, namely interpreting a mathematical concept. Next, in the Demonstrate step, students will present the results of their concept discoveries to translate and apply their knowledge. The next step is Repeat, students are directed to repeat the material studied in order to strengthen neural connections in understanding mathematical concepts. This is in line with the opinion of Sahriani et al. (2017) that repetition in learning allows students to feel directly where their difficulties are in the learning process so that repetition can strengthen neural connections and foster a sense of knowledge or confidence in students' abilities.

Quantum learning model is a model that can support the ability to understand mathematical concepts. In this way, students' mathematical understanding abilities taught using the quantum learning model assisted by Geogebra can support students' ability to understand mathematical concepts in cubes and blocks at SMP Ikhlasiyah Palembang.

CONCLUSIONS AND SUGGESTIONS

From the results of data analysis and discussion, it can be concluded that students' ability to understand mathematical concepts with quantum learning model is have good category. It was found that students' ability to understand concepts was categorized as good with an average score of 80.02 which is measured from indicators of understanding mathematical concepts, namely restating a concept, classifying objects according to certain properties by the concept, giving examples and non-examples of concepts, presenting concepts in various forms

of mathematical representation, developing necessary or sufficient conditions for a concept, use and utilize and select certain procedures or operations, and apply concepts or algorithms to problem-solving. It is hoped that the results of this research can be used as an alternative for teachers in the learning process, especially in learning, and for future researchers to be able to use the quantum learning model in other research materials and subjects to measure the level of mathematical literacy abilities.

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