Learning the Concept of Absolute Value with Multi Representations Approach-Based Instructional Video

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Abstract. This study intends to illustrate how students comprehend the idea of absolute value after learning it through video media using a multi-representational approach. A descriptive research methodology is used in this study. 67 students from SMA PGRI 2 Palembang's class X participated as the study's subjects. This study was carried out in 2021–2022, during the even semester. In order to gather the data for this study, exams, interviews, and documentation were used. Using a multi-representational approach, this study aims to demonstrate how students comprehend the concept of absolute value after learning it through video media. This study employs a descriptive research methodology. The subjects of the study were 67 students from SMA PGRI 2 Palembang's class X. This research was conducted in the even semester of 2021–2022. This study's data was gathered through exams, interviews, and documentation. Data was analyzed using descriptive quantitative methods to exemplify students' comprehension. The ability to understand the absolute value is analyzed for each indicator of concept understanding ability. The indicators used in this study are defining absolute values, interpreting solution graphs from solving absolute value equations and inequalities, and solving absolute value equations and inequalities. Understanding formulations in determining solutions and solving absolute value equations and inequalities Students had excellent knowledge of the concept of absolute value after learning using a video-based multi-representation technique, according to the findings. The mean score for students' understanding of absolute value was 72.31%. As a result, using this instructional video format can assist students in comprehending absolute values.

Keywords: Absolute value · Multi-representation

1 Introduction

We use various representations of problems and ideas in mathematics to communicate our thinking to ourselves and others. In many ways, representation can be considered the language of mathematics. When we consider representation as a process of illumination of ideas rather than an image (e.g., graph, table, diagram), we can see its utility in mathematics learning [1, 2].

The concept of absolute value is one of the mathematical concepts that can be represented in a variety of ways. The absolute value is a real number, such as x, and is

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represented by the symbol |x|. In the context of arithmetic, absolute value is defined as follows:

$$|x| = \begin{cases} x \ for \ x \geq 0 \\ -x \ for \ x < 0 \end{cases}$$

In geometry, absolute value is defined as the distance x from the origin [3]. As a result, the absolute value will always be positive.

Absolute value is taught to grade X students in Indonesia. It is one of the materials that students find difficult to grasp [4], even for every level of education [5]. Despite the fact that this material is also in the category of difficult to teach. This is due to the fact that in order to comprehend it, students must first master the concepts of supporting absolute values, such as integers and arithmetic. Students do not understand when and why a procedure or algorithm works to solve absolute value problems. Furthermore, Goldrick-Rab [3] claims that students remember only a few formulas in the concept of absolute value. Students are unable to integrate their reasoning and answer the question, "How can this happen?".

In line with that, [6] proposed conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition as indicators of understanding mathematical concepts. The ability to understand mathematical objects, including operations and relations, is referred to as conceptual understanding ability. The ability to apply procedures appropriately, efficiently, and accurately is referred to as procedural fluency. Strategic competence, on the other hand, is the ability to formulate, represent, and solve mathematical problems. The ability of adaptive reasoning includes the ability to think logically, reflect, explain, and justify, and the ability of productive disposition includes the ability to see mathematics as useful.

The following are some of the difficulties students have in understanding the concept of absolute value: a) students do not understand the definition of absolute value [7]; b) students find it difficult to determine the completion interval of absolute value equations or inequalities (especially for negative and positive signs) [4, 8, 9]; c) students find it difficult to apply the properties of absolute values in the problem solving process; and graphs of completion from absolute values are difficult to make [10]. Students must be able to recall several steps and follow them correctly, or else the solution obtained will be incorrect [3].

As a consequence, numerous studies have been conducted to help students understand the concept of absolute value. One method is to employ a learning strategy and/or learning media, such as using GeoGebra [11]. The identified learning media can visually present mathematical concepts. A number line, for example, can help to visualize the concept of absolute value [3]. As a result, it is hoped that the use of appropriate learning media will improve students' comprehension.

The multi-representation approach is one of the learning approaches that is consistent with the characteristics of the absolute value concept. The multi-representation approach presents information in a variety of formats [1], making it easier for students to understand the subject matter [12]. Multiple representations can describe different aspects of a real-world situation, as well as the same aspect in different ways. Representations include the following: (1) verbal representation; (2) diagrams; (3) graphical representations; and (4) mathematical representations.

Multiple representations are commonly used in mathematical research to help students improve their mathematical concepts. Monk [13] discusses two graphs: one to transmit meaning or as a communication tool, and the other to gain meaning through analysis and investigation. Based on this situation, it is possible to conclude that the mathematics teacher's goal is not only to communicate the characteristics of the concept, but also to encourage students to understand the concept in a novel way.

Teachers in the 4.0 industrial revolution must be able to capitalize on scientific and technological advancements in addition to using a multi-representation approach. Learning videos are one type of resource that can support a multi-representation approach because they include a variety of representations that can assist students in understanding the subject matter. Video is a type of learning media that uses images, sounds, animations, or illustrations to depict events from the material being studied. Using videos as a learning media in mathematics can improve students' motivation, students' understanding and achievement [14].

In accordance with the explanation, the researchers are interested in conducting learning using instructional video media based on a multi-representation approach. This study is a continuation of [15] research on the development of absolute value learning video media using a multi-representation approach. In this study, the formulation of the problem is how students understand the concept of absolute value after learning with video media using a multi-representation approach. In this study, the indicators for understanding mathematical concepts are restricted to aspects of understanding mathematical concepts. Understanding mathematical concepts is demonstrated by the ability to interpret, explain, formulate, and perform mathematical calculations.

2 Method

The purpose of this study is to describe students' understanding of the concept of absolute value through instructional video learning using a multi-representation approach. This study is both quantitative and descriptive. This study included 68 students from SMA PGRI 2 Palembang's grade X. The study was conducted during the odd semester of the 2021–2022 academic year. The video media used in this study can be found at https://youtu.be/amrmPZog1S4 (instructional video 1) and http://youtu.be/VoWz1XT4SY4 (instructional video 2). Data for this study were gathered through description tests, interviews, and documentation. The test was designed to assess students' understanding of the concept of absolute value. The examination questions were adapted from [13]. Students' understanding of the concept of absolute value was supported by interviews and documentation. Based on a multi-representation approach, the data was then descriptively analyzed to provide a clearer depiction of the students' understanding after learning with instructional video based multi representations approach.

3 Result and Discussion

The purpose of this research is to describe students' understanding of absolute value after learning with instructional videos using a multi-representation approach. The learning video based on a multi-representation approach with the learning phase refers to Sunyono in [15], the learning process as follows:

Fig. 1. Orientation Phase.

1) Orientation phase: a) Provide basic competencies and absolute value learning objectives; b) Provide students with an overview or phenomenon of the absolute value concept to be studied. This learning phase can be seen in Fig. 1.

2) Exploration Phase: Introduce and present to students the concept of absolute value using a variety of representations, including verbal, mathematical, and graphical representations. This implemention phase can be seen ini Fig. 2.

Figure 3 is a video explanation of the idea of absolute value.

Fig. 2. Exploration Phase.

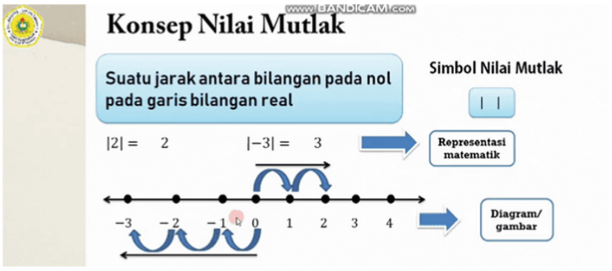

Fig. 3. The video display

3) Internalization Phase: Encourage and guide students to complete the practice questions. The implementation of this phase can be seen in Fig. 4.

Students are asked to work on discussion sheets related to understanding the concept of absolute value at this stage. The worksheet answers for absolute value are shown in Fig. 5.

4) Evaluation Phase: a) Provide a review of students' work; b) Provide students to make conclusions about the material; and c) Close the lesson by greeting students.

After learning the concept of absolute value, students are required to take a test to demonstrate their understanding of the concept. The test is in the form of a description essay, and it is designed to assess students' understanding of the concept of absolute value after they have learned to use video media using a multi-representation approach. The following table shows the results of the students' understanding of the concept of absolute value:

Fig. 4. Internalization Phase.

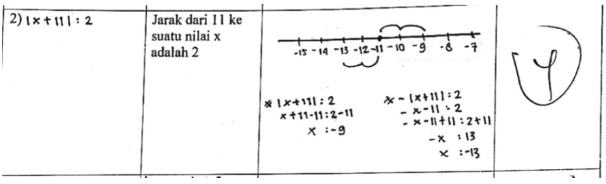

Fig. 5. The examples result of students worksheet

Table 1. Students' conceptual understanding of absolute value

Score	Frequency	Category
81–100	11	Very Good
61–80	51	Good
41–60	6	Enough
21–40	0	Poor
	68	

Table 2. Students' score for each of conceptual understanding indicator

Indicator Conceptual Understanding	Mean Score	Category
definition of absolute value of a variable	42.91	Poor
Definition of absolute value of a constant	71.64	Good
Graph interpretation for absolute value equation solutions	75.37	Good
graph interpretation for solutions to absolute value inequalities	50.00	Poor
formulate the problem to determine the solution	66.79	Good
Find the answer to the absolute value equation	76.87	Good
Find the answer to the absolute value equation	68.66	Good

Table 1 indicates that students' comprehension of the idea of absolute value 51 people fall into the good category, 6 fall into the really good category, and 11 go into the very good category. This demonstrates that students' knowledge of the idea of absolute value is in the good category after using learning video material based on a multi-representation method. The mean score was 72.31% with good category.

Additionally, data analysis was done to determine student performance on each concept understanding indicator. Generally, there are four components to grasping the subject in this study: explaining, interpreting, formulating, and doing mathematical calculations.

The following Table 2 shows the findings of data analysis for each concept understanding indicator:

Based on Table 2, the data description of students' conceptual understanding of absolute value can be explained as follows:

3.1 Explain the Definition of Absolute Value of a Variable

According to Killpatrick, et al., in [16] indicators included in adaptive reasoning ability, is the fourth dimension of understanding mathematical concepts. In this section, students explain that the absolute value of a variable is the distance of a certain number from point 0 on the number line regardless of its direction. However, many students only answered by explaining that the absolute value is a value that is always positive, without giving the reason that the variable x can be replaced by a number, either negative or positive. The score for the indicator explaining the definition of the absolute value of a variable is 42.91% with a fairly good category. This is in line with [7, 17].

3.2 Explain the Definition of Absolute Value of a Constant

In this section, students explain that the absolute value of a constant is the distance of a number from point 0 on the number line regardless of its direction. Students can understand and explain the definition of absolute value of a constant well, as well as give reasons to calculate distance using a number line. This is because students can determine the point of a constant to 0 and calculate the distance. The score for the indicator explains the definition of the absolute value of a constant of 71.64%, with a good category.

3.3 Graph Interpretation for Absolute Value Equation Solutions

In this section students interpret the graph of the solution to the absolute value equation. From the graph in the form of a number line, students are asked to be able to determine the absolute value equation. In this case students must know the concept of absolute value which is the distance from a number to the origin. The score for the graph interpretation indicator for the solution of this absolute value equation is 75.37%.

3.4 Graph Interpretation for Solutions to Absolute Value Inequalities

In this section, students interpret graphs of solutions to absolute value inequalities. From the graph in the form of a number line, students are asked to be able to determine the absolute value of the inequality. Like with absolute value equations, to solve this problem, students must understand the concept of absolute value inequality. The score for the chart interpretation indicator for the solution of this absolute value equation is 50.00%, in the low category.

The low score of the interpretation of the inequality graph is due to the lack of students' understanding of the concept of inequality expressed on a number line. This was obtained based on the results of interviews with students who stated that they did not understand the concept of inequality and its solution with a number line.

3.5 Formulate the Problem to Determine the Solution

In this section, students are asked to be able to formulate what is meant by the question based on their understanding of the concept of absolute value. The score for understanding this formula is 66.79%. This is in line with [10].

3.6 Find the Answer to the Absolute Value Equation

In this section, students are asked to solve the absolute value equation based on the definition of absolute value that has been understood. The score of this indicator is 76.87%. Counting is a student's ability to carry out calculations or apply formulas in similar cases. According to Skemp [6], counting is one of the abilities of procedural understanding. Students do not have difficulty counting activities.

3.7 Find the Answer to the Absolute Value Inequality

In this section, students are asked to solve absolute value inequalities. The student score for this indicator is 68.66%. This lower score indicated that students' did not understand about inequalities [8].

4 Conclusion

According to the study's findings, students' understanding of absolute value concept after learning with multi-representations approach based instructional video is in a good category. The study of each indicator's data reveals that the indicator that measures how well pupils comprehend a concept is the absolute value equation's completion calculation. The indicator that defines the absolute value of a variable has the lowest level of achievement. As a result, it is recommended that future studies look for ways to clarify this definition of absolute value.

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