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Multiple Representations Appear When Students Interpret Signs in Constructing Rectangle Concepts

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ABSTRACT

Multiple Representation the ability to use several mathematical expressions. The purpose of this study is to describe the representations that appear when students interpret the signs. Descriptive explorative research is used in this study with three elementary school students in the Jember Regency. The research was conducted teacher's teaching process, recording students 'activities using field note sheets, and analysing the results of students' notes when constructing concepts. The research findings showed that the subject interpreted the sign by investigating the sign and then using some interpretations to express his mathematical ideas in the form of writing, pictures, tables, numbers, and symbols. This shows when interpreting the subject's sign using multiple representations. The representations used are image, verbal, and symbol representations. The results of this study are useful for teachers to stimulate children to make more than one representation when constructing a rectangle concept.

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A. INTRODUCTION

Representation is a element in the constructing and learning mathematics, not only because of systemic which are very important in mathematics, rich, varied, and universal syntax and semantics (Suryaningrum et al., 2018). Representative ability is one of the abilities students must have in learning mathematics because representation has an essential role in mathematical problems (NCTM, 2000). The ability of students to represent problems in various forms can provide opportunities to build different approaches to the same problem, so that students do not focus on one idea and one representation (Cankoy & Özder, 2011).

The representation will help students in assist the thinking process (Madrid et al., 2015; Zhe, 2012). In this case, representation helps students in arranging abstract mathematical ideas to be more concrete and tangible. The use of multiple representations in mathematics learning can retain the understanding of mathematical concepts and arouse students' interest in mathematics. The representations made can vary depending on the ability of each individual to interpret the existing problems (Minarni et al., 2016). Multiple mathematical

representation ability is the ability to use various mathematical expressions, namely visuals (graphs, tables, diagrams, and pictures); symbolic (mathematical statement / mathematical notation, numeric or algebraic symbols); verbal (words or written text) (Chen & Lee, 2015; Kang & Liu, 2018; Zhe, 2012).

Multiple mathematical representation ability is the ability to use various mathematical expressions to explain mathematical ideas, interpret mathematical phenomena with various mathematical expressions, namely visuals (graphs, tables, diagrams, and pictures); symbolic (mathematical statement / mathematical notation, numeric or algebraic symbols); verbal (words or written text) (Chen & Lee, 2015; Durkaya et al., 2011; Sari et al., 2018). Activity in the forms of visual representations (graphs, tables, diagrams, and pictures) are displaying information from a mathematical expression in a diagram, graph, or table representation, using visual representations in solving problems, Solving problems using pictures -drawing geometry, making geometric drawings to understand a problem to find a solution (Boonen et al., 2014). The forms of indicators of symbolic representations (mathematical statements / mathematical notations, numeric, or algebraic symbols) are (a) Making equations from the problems presented, (b) Making conjectures from number patterns, (c) Solving mathematical problems using algebraic symbols. Indicator forms of verbal representation (words or written text) are (a) Expressing a given problem in the language itself (b) Writing interpretations in a language that is easy to implement, (b) Compiling a story that fits a problem that is presented, (c) Writing down the stages of problem-solving in words or written text, (d) Answering questions using words or written text (Suryaningrum et al., 2019).

A concept, object, and sign can be interpreted endlessly (Gravells, 2017; Schreiber, 2013). Signs can be visual, verbal, musical, and gestural. A sign is a representation of an object. Interpretation is a thought or notation to represent an object. A sign only acts as a sign if a subject considers it a sign, interpreters only exist if there is a sign (Sendera et al., 2014; Turkcan, 2013). On the other hand, nothing can act as a sign if there is no interpreter, this being an indispensable element of the triadic sign relationship. Therefore each sign can act as an object or as an interpreter of other signs. Interpreting activity is an activity in semiotic reasoning. In this study, semiotic reasoning occurred when students constructed the long square concept. Interpretation or sign users is the concept of thinking of people using signs and lowering it to a particular meaning or meaning in someone's mind about the object referred to by a sign (Yang & Hsu, 2015; Kralemann and Lattmann, 2013). The most important thing in semiosis is how meaning emerges from a sign when the sign is used by people when communicating. Interpretation is a response to an object through the mediation of signs. Interpretation can also be called a reaction of signs, feelings, and thoughts which is the meaning of the sign.

Several researchers have researched multiple representations and interpretations. Among them are the results of research (Delice & Sevimli, 2010) which state that the most frequent representations used by student-teacher candidates for correct answers are algebraic representations in the problem-solving process (18.7%) and numerical representations (2.8%). For wrong answers, the representations used are algebraic representations (13.1%) and mixed representations (1.6%). The use of mixed representations for wrong answers is 7% for all. Research results (Bal, 2014) show that, using multiple representations can help

understand the problem easily and according to demand in understanding a problem. At the evaluation stage, the subject expresses that using representations is effective in solving problems. The results of the study (Turkcan, 2013) stated that the semiotic analysis carried out on student images was not only a tool that helped make psychological descriptions but also an approach that supported the mental development process of students. (Suryaningrum et al., 2020) conduct research on interpretation failures. The results of this study indicate that there is a failure by the research subjects in interpreting semiotic representations. The subject failed to interpret the sign that had been made which resulted in an error in solving the problem. From several studies that have been conducted by previous studies, no one has examined multiple representations in interpreting signs. In this study, the interpretation of signs is a student's point of view in interpreting signs. Several representations appear when students interpret signs. The main objective of this research is to identify the representation of students when interpreting signs in semiotic learning in constructing the rectangular concept.

B. METHODS

This research used qualitative research by using case study. Qualitative describ and analyze phenomena, events, social activities, attitudes, beliefs, perceptions, and people's thoughts individually or in groups (Fuster, 2019). The subjects of this research consisted of three elementary schools students in the Jember district. The criteria for selecting research subjects are 1) elementary school students in grade 4 aged 9-10 years, 2) students can communicate their reasoning well (orally and in writing), 3) students carry out semiotic reasoning in constructing rectangular concepts, and 4) students use multiple representations when interpreting the sign. The multiple representations referred to in this study are visual representations, verbal representations and symbolic representations.

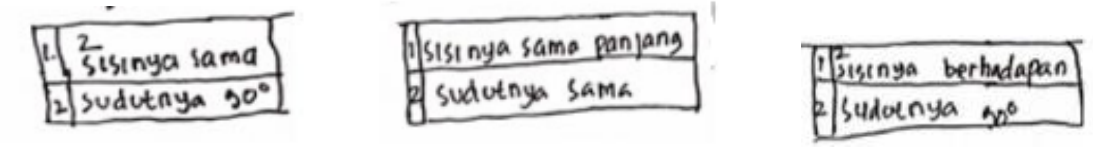
The research was conducted by observing and collecting student notes when learning mathematics with rectangular material. Interviews were conducted with students after learning. The research data were obtained from observations of research subjects when doing semiotic reasoning, the results of students' notes when interpreting signs, the results of in-depth interviews with research subjects so that researchers could explore the descriptions of the research subjects. The data is analyzed to describe the representations that appear when students interpret the signs in constructing the rectangular concept. The data analysis stage carried out in this study is a modification of the qualitative research needs analysis developed by (Creswell, 2012). The steps taken to analyze the data are (1) processing and preparing the data is grouping the data based on the representation, (2) copying the data is an activity to change the verbal data into written form, (3) reducing the data includes the activity of selecting the appropriate data and discarding the data. data that is not needed, (4) describing data is an activity to link a series of narratives related to representations that appear when interpreting signs, (5) triangulation is a technique to compare the results of representations in interpreting signs with the results of interviews (Herdani & Ratu, 2018) and (6) drawing conclusions is an activity to describe multiple representations that appear when interpreting signs.

C. RESULT AND DISCUSSION

Interpretation of signs is an activity to interpret signs and this activity is carried out by students when constructing a rectangular concept. This study, describes the representations that appear when students interpret the signs in constructing the concept of a rectangle. The subjects of this study consisted of three students, namely subject 1 with the initials AZ, subject 2 with the initials RR and subject 3 with the initials KS. In total, the representations that appear when students interpret the signs are described as follows.

1. First Subject (AZ)

AZ collects objects in the class whose surface is rectangular. They found three rectangular objects from the observation, namely a creation board, a blackboard, and a pencil case. The three objects are then observed to find their characteristics. From the observations, AZ found the features of objects whose surfaces are rectangular. AZ defines the properties of the rectangle. For rectangular objects in the shape of a creation board, AZ finds that the characteristics are the same sides, the angle is 90^o, the objects are rectangular in the shape of a blackboard, AZ finds that the features are the same sides, the angles are the same, the objects are rectangular in the shape of a blackboard. Pencil case, AZ found that its characteristics are the sides facing and the angle is 90^0. The activity of finding the features of objects whose surfaces are rectangular, proves that AZ has interpreted the sign. The proof of representation records in mentioning the characteristics of objects identified by AZ at the sign interpretation stage can be seen in Figure 1.



Translation:

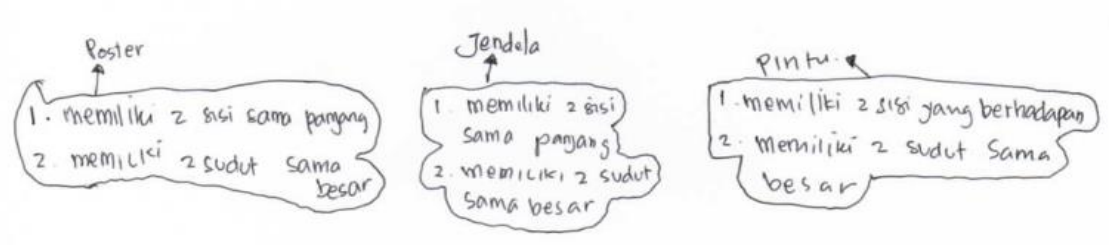
1. It has two equal side	1. It has equal sides	1. Its sides are opposite
2. Its angles are 90^0	2. The measure of its equal	2. Its angles are 90^0

Figure 1. AZ Notes on Finding the Properties of a Rectangle

From the notes that AZ interpreted signs, AZ used verbal representations, pictures, and symbols. Verbal representations are used by AZ to write rectangular features, visual representations in the form of tables are used to separate each feature of objects whose surfaces are rectangular, AZ uses symbol representations write the number of features of objects whose surfaces are rectangular found by AZ.

2. Second Subject (RR)

RR collects objects in the class whose surface is rectangular. From the observations, RR found three rectangular objects, namely posters, windows, and doors. The three objects are then observed to find their characteristics. From the observations, RR found the features of objects whose surfaces are rectangular. RR defines the properties of the rectangle. For a rectangular object in the form of a poster, RR finds its characteristics are that it has two equal sides, has two equal angles, a rectangular object shaped like a window, RR finds its characteristic is it has two equal sides, has two angles an equal, rectangular object shaped like a door, RR finds its characteristic is that it has two opposite sides, two equal angles. From the activity of discovering the features of objects whose surfaces are rectangular, it is evident that RR has carried out the stage of interpreting the sign. The proof of representation notes in mentioning the characteristics of objects identified by RR at the sign interpretation stage can be seen in Figure 2.



Translation:

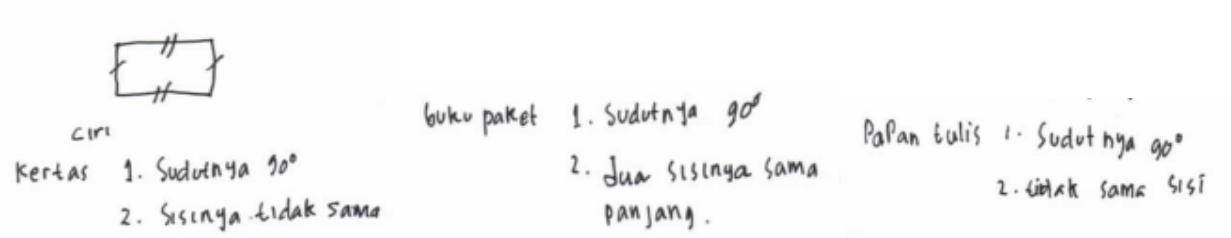
1. It has two equal sides	1. It has two equal sides	1. Its two sides are opposite
2. It has two equal angles	2. It has two equal angles	2. It has two equal angles

Figure 2. Note RR in Finding the Properties of a Rectangle

From RR's notes in interpreting signs, RR uses verbal representations, pictures, and symbols. Verbal representation is used by RR to write rectangular features, visual representation in the form of a closed curve is used to separate every feature of objects whose surface is rectangular, RR uses symbolic representation to write the number of features of objects whose surface is rectangular found by RR.

3. Third Subject (KS)

KS collects objects in the class whose surface is rectangular. From the observations, KS found three rectangular objects, namely paper, textbooks, and whiteboards. The three objects are then observed to find their characteristics. From the observations, KS found the characteristics of objects whose surfaces are rectangular. KS specifies the properties of the rectangle. For rectangular objects, namely paper, KS finds its characteristics are 90^0 angles, unequal sides, rectangular objects in the shape of a blackboard, KS finds its features are 90^0 angles, unequal sides, rectangular objects shaped like notebooks KS found that its characteristic is that the angle is 90^0, the two sides are the same length. From the activity of finding the features of objects whose surfaces are rectangular, it proves that KS has carried out the stage of interpreting the sign. The proof of representation records in mentioning the characteristics of objects identified by KS at the sign interpretation stage can be seen in Figure 3.



Translation:

1. Its angles are 90^0	1. Its angles are 90^0	1. Its angles are 90^0
2. sides are not equal	2. It has two equal angles	2. sides are not equal

Figure 3. Note KS in Finding Rectangular Properties

From KS's notes in interpreting signs, KS uses verbal representations, pictures, and symbols. The verbal representation is used by KS to write the features of the rectangle, the visual representation in the form of a rectangular image is used to show the length of the two sides of the rectangle facing each other, KS uses the symbolic representation to write the number of features of the object whose surface is rectangular found by KS.

At the stage of interpreting the sign, the three subjects used a variety of representations. The three subjects show the characteristics of objects whose surfaces are rectangular to define rectangular features using verbal representations. This follow the opinion (Bal, 2014) which states the most widely used representation is a verbal representation at the stage of planning completion compared to graphical and algebraic representations. The subject uses verbal representations to write the features of objects whose surfaces are rectangular. This is following the opinion (Madrid et al., 2015) which states that verbal and numeric representations are often used to express concepts and examples. The visual representation used by the subject is in the form of tables, pictures, and closed curves. This activity supports the opinion (Suryaningrum et al., 2019) which implies that the forms of visual representation can be in the form of graphs, tables, diagrams, and pictures. The visual representation used by the three research subjects is used to make it easier to understand the problem. In elementary school children, it is used to make it easier to understand abstract mathematical concepts. This follow the opinion (Bal, 2014; Boonen et al., 2014) that using visual representations can understand abstract mathematical concepts.

The symbol representation used by the subject is a symbol of numbers and algebraic symbols. This follow the opinion of (Suryaningrum et al., 2020) which states that one of the indicators of symbolic representation is solving mathematical problems using algebraic symbols. The three subjects use visual, verbal, and symbolic representations to make it easier to understand mathematical ideas. This is following the opinion (Amaliyah & Mahmud, 2018) which states that to connect mathematical ideas, they can represent these ideas through pictures, graphics, symbols, or words to become simpler and easier to understand.

D. CONCLUSION AND SUGGESTIONS

Interpreting the sign is one of the activities in semiotic reasoning in constructing the long square concept. Interpreting the sign is an activity to interpret the sign to find the concept of a rectangle. From the research findings, it can be said that the activities carried out by the subject in interpreting the sign are carried out by conducting an investigation of the sign using several interpretations. Various representations appear when students interpret signs. The representations used are visual representations in the form of tables and pictures, representations in the form of numeric or algebraic symbols, verbal representations in the form of words or written text. This shows that at the sign interpretation stage, the subject uses multiple representations. Representations used by research subjects are visual representations, verbal representations, and symbol representations

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