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WAYS OF THINKING LINEAR WITH ABILITIES: A CASE FROM THE INCLUSIVE CLASSROOM

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ABSTRACT

This research aims to obtain a description of the relation between various ways of thinking and students' abilities. The research was conducted in an Inclusive Junior High School in the West Java Province, Indonesia. This study is qualitative, with single-case (holistic) designs. The data were collected through student tests, observations, document analysis, and teacher interviews. The data analysis was conducted using grounded theory with constant comparison. The results showed that based on the number of ways of thinking, students can be divided into three groups; there are the low, middle, and high groups. The low group performed one way of thinking, the middle group performed two-three ways of thinking, and the high group performed four ways of thinking. Surprisingly, students who have various ways of thinking, they have more abilities.

Kata Kunci: inclusive classroom; students' ability; mental acts; ways of understanding; ways of thinking

INTRODUCTION

Based on data from the Ministry of Education and Culture of the Republic of Indonesia, the number of inclusive junior high schools in Indonesia is 3,817, while the number of inclusive students is 24,985 (Kemdikbud, 2011). This data shows a large number. On the other hand, research that studies mathematics learning in the setting of inclusive education is still not widely done. The results of research on the practice of inclusive education (McKenna, Shin, & Ciullo, 2015) identified only five studies published between 2000 and 2013 related to learning mathematics in an inclusive school setting.

In teaching and learning mathematics, inclusive schools will likely receive two types of students, some students who have difficulty in mathematics, and students who have no difficulty in mathematics. Furthermore, students at inclusive schools also vary, from the low achievers to the high achievers. Some literature discussed learning mathematics in an inclusive setting. For example, the equity principle (NCTM, 2000), which states that all students must have opportunities to study mathematics. They also must be supported to learn mathematics; regardless of their impairment.

Some researchers stated that students grasp mathematical ideas and construct them in a variety of ways, depending on their unique experience in mathematics learning. Teachers' appreciation of the difference between these students will increase students' confidence in learning mathematics and make students' mathematical understanding more deeply (Castellon et al., 2011; Schifter, 2005; Zevenbergen et al., 2004). Therefore, investigating students' ways of thinking on understanding mathematics is important.

In this study, we use fractions for the research topic. Understanding fractions material is very crucial for students in learning mathematics. Fractions are the foundation for learning algebra and mathematical material at a higher level (Bailey et al., 2012; Torbeyns et al., 2014; Shin et al., 2016).

Taking into account all the considerations above, research on students' ways of thinking on fractions in the inclusive classroom is needed as an essential first step toward effective instructional methods. Therefore, the problem of this research is how the relationship between students' ways of thinking and their abilities in fraction learning.

The topic used in this study is fractions. According to Clarke, et al. (2010: 15), the definition of fractions is as follows:

"*A fraction is a symbolic expression that represents the results of two numbers* $\frac{a}{b}$ *(with b not equal to zero). So, all rational numbers expressed in form* $\frac{a}{b}$ *are fractions, but rational numbers 1.45 are not fractions. The 1.45 rational number can be called a fraction if it is written* $\frac{145}{100}$*. So, all rational numbers can be written as fractions, but some important fractions are not rational numbers, for example:* $\frac{\pi}{4}$ *or* $\frac{\sin\frac{\pi}{4}}{2}$*.*"

Students and the teacher use fractions handout which were adapted from Cramer et al (2009); the handout approach was called Lesh Multiple Translation Model (Cramer, 2003). To analyze the students' thinking, we used Harel's theory: Mental Act, Ways of Understanding, and Ways of Thinking (Harel, 2008a).

Mathematics is the set of ways of understanding (WoU) and ways of thinking (WoT) (Harel, 2008a). WoU is the product of mental acts; it consists of axioms, definitions, theorems, proofs, problems, and solutions. WoT is the characteristic of mental acts; it consists of all the ways of thinking that are used to produce WoU.

The mental act is a characteristic of thinking in line with the problems encountered; a WoU is a specific cognitive product of the mental act performed by an individual; a WoT is the cognitive character of the mental act. The cognitive characteristics of the mental acts are inferred from the observation of the WoU (Harel, 2008a).

METHODS

This study involves purposeful sampling. The sample is chosen by researchers' judgment to select an information-rich sample (Gall, Gall, & Borg, 2010). This research is conducted in one of the Inclusive Junior High Schools in West Java, Indonesia. The location of school is in an urban area. The participants are 27 students in the 7th grade; they learn fraction topics using a handout that implements Lesh Translation Model. They have learned basic fraction concepts from the 3rd grade, and in the the7th grade, they finished all the learning on fractions topic.

The data were collected through student tests, observations, document analysis, and interviews (Gall, Gall, & Borg, 2010). After we obtained the result of the students' test, we interviewed the teacher. The purpose of the teacher interview was to confirm the result of the test for each student. The major question for teacher interviews is "Does the ability of students fit with the score of their test?". The result of the teacher interview revealed that the test score matches the ability of the students.

The observation is conducted when students attend fractions learning and when they completed the test problems. The purpose of the observation is to make sure students learn and solve the fraction problem seriously. The data analysis of this study aims to analyze the relationship between students' ways of thinking and their abilities in fraction learning. The grounded theory with coding and constant comparison technique is used for data analysis. The grounded theory procedures as stated by Gall, Gall, and Borg (2010) through the four steps, namely (1) data collection; (2) data division into several segments; (3) defining specific categories that reflect both the conceptual and structural elements of the data; and (4) coding of each segment for each appropriate category in each segment.

RESULTS AND DISCUSSION

Results

We find the number of mental acts (MA), ways of understanding (WoU), and ways of thinking (WoT) as follows:

Table 3. The number of MA, WoT, WoU, and the score of the ability of 27 students

No	Respondents	# MA	# WoT	# WoU	Ability Score
1	27	1	1	1	15
2	1	1	1	1	20
3	8	1	1	1	20
4	26	1	1	1	20
5	25	1	1	1	25
6	19	1	1	1	26
7	13	1	1	1	30
8	16	1	1	1	35
9	17	1	1	1	35
10	20	1	1	1	35
11	21	1	1	1	36
12	12	1	1	1	40
13	3	2	2	2	55
14	10	2	2	2	56
15	15	2	2	2	56
16	2	2	2	2	60
17	11	2	2	2	60
18	23	3	3	3	66
19	9	3	3	3	73
20	7	4	4	4	81
21	5	4	4	4	83
22	6	4	4	4	83
23	24	4	4	4	86
24	22	4	4	4	95

25	14	4	4	4	96
26	4	4	4	4	100
27	18	4	4	4	100

From table 3, we classify the participants based on the number of MA, WoT, and WoU, with the following criteria:

1. The low groups are students with the numbers of MA, WoT, and WoU equal to one;
2. The middle groups are students with the numbers MA, WoT, and WoU equal to two and three;
3. The high groups are students with the numbers of MA, WoT, and WoU equal to four.

Low Group Students

Based on the criteria above, the number of students in the low group is twelve. Two mental acts are found, which are interpreting and problem-solving, with corresponding WoT and WoU. In the lower group students, we only identify one mental act for each student, with the relevant WoU and WoT. We find eleven students doing mental act interpreting and one student (respondent 8) doing mental act problem-solving.

Middle Group Students

Based on the criteria, the number of students in the middle group is seven. In middle group students, mental acts are more varied, ranging from interpreting, explaining, and problem-solving, to inferring, each with corresponding WoU and WoT.

In the middle group of students, we identify four mental acts with relevant WoU and WoT. We find two students doing mental act interpreting and problem-solving; three students doing mental act interpreting and explaining; one student doing mental act interpreting, explaining, inferring; and one student doing mental act interpreting, explaining, and problem-solving.

High Group Students

Based on the criteria, the number of students in the high group is 8. In high group students, each student shows four mental acts; there are interpreting, explaining, problem-solving, and inferring, each with corresponding WoU and WoT. In the high group of students, we identify four mental acts with relevant WoU and WoT for each student, that is interpreting, explaining, problem-solving, and inferring.

Surprisingly, the number of MA, WoU, and WoT of the lower, middle, and high group students has a linear relationship with the score of ability, we find that the student who has more various ways of thinking have more score of ability.

Discussion

Some reasons may be the cause of why students in the low group can only show one mental act, with relevant WoU and WoT. One possible explanation is that there may be students who are suspected of having a mathematics learning disability (MLD). Based on observations, test results, and interviews with teachers, we found four students suspected of having MLD.

According to the result of the data analysis, the 25th percentile (first quartile) of the score is 32.5. A score of 32.5 indicates the upper bound of 25% of the lowest score. Based on Geary (2004), one way to determine the MLD student is the students whose test results are below the 25th percentile. By paying attention to scores that are below the 25th percentile, 7 students are suspected of experiencing MLD. The students are respectively number 27, 1, 8, 26, 25, 19, and 13. After class observation and the teacher interview, we agree that there are only four students who experienced MLD. Students with MLD are respectively number 1, 8, 19, and 26.

We find that students with MLD can only solve the problem procedurally. They cannot use inferring and explaining yet. This finding is in line with our previous research that MLD students can only do one mental act, namely interpreting or problem-solving (Ikhwanudin & Suryadi, 2018).

Another possible explanation for the low achievers only showing one mental act is that this study uses multiple representation models. Some researchers argue that multiple approaches to solving a problem are problematic for low achievers. They state that one simple set of rules is the best approach to teaching these students (Baxter et al, 2001).

In the high group of students, we identify four mental acts for each student, namely interpreting, explaining, problem-solving, and inferring, each with corresponding WoU and WoT. One possible explanation for why the high group can show four mental acts is offered by Elia et al (2009), which state that multiple strategies approach for problem-solving is appropriate for the high achievers, in this study we use multiple representation models.

Another possible explanation is the concept of mathematically gifted. In the high group, we identify two of eight students as mathematically gifted. Based on Mann (2006), identifying mathematically gifted students can be done through observing the performance of students in the classroom, test scores, and recommendations. After class observations, test results, and teacher recommendations, we find two students that are suspected as mathematically gifted, namely students 4 and 18, who get the scores of 100 on the test.

In problem-solving, the gifted student uses more methods to solve problems compared with their peers. This finding is in line with Hong and Aqui (2004) notice that gifted children use more strategies to organize and transform information and use it more effectively. In interpreting and explaining, we also find that gifted students solve problems by creating schemas or drawings; they can visualize the mathematics problem. This finding is in line with the study of Presmeg (1986) which stated that the gifted student could visualize problems and relations.

Furthermore, we also find that the gifted student uses mental acts inferring to conclude (inference). Another research finding from Polya and Kiesswetter (in Sriraman, 2005) concluded a similar result; which stated that gifted students can think analogically and heuristically and pose related problems.

CONCLUSION

The inclusive school system is one implementation of the equity principle in teaching and learning mathematics. Therefore, a study on students' way of thinking when understanding mathematics in an inclusive classroom is very important. In this study, we find that students who have various ways of thinking, they have more abilities.

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