Journal of Education, Teaching and Learning
Volume 5 Number 2 September 2020. Page 229-237
p-ISSN: 2477-5924 e-ISSN: 2477-4878

UNDERSTANDING OF MATHEMATICAL CONCEPTS AND STUDENTS' SELF-REGULATED LEARNING IN RME LEARNING ASSISTED BY PANDU

Citra Utami[1)], Rien Anitra[2)], Usinah Robert Moseki[3)]

[1)]*STKIP Singkawang, Singkawang, Indonesia*
E-mail: citrautami1990@gmail.com

[2)]*STKIP Singkawang, Singkawang, Indonesia*
E-mail: anitrarien@gmail.com

[3)]*Oodi College of Applied Arts & Technology, Botswana, South Africa*
E-mail: usihmoseki@gmail.com

Abstract. The understanding of mathematical concepts has an important role in one of the knowledge and activity skills in mathematics learning according to NCTM. On the other hand, self-regulated learning is one aspect that also determines the success of students' mathematics learning. Facts in the field, the understanding of concepts, and self-regulated learning students' are still low. Based on this, the need for contextual learning and the existence of teaching aids in learning mathematics. The purpose of this study is to find out the increase in understanding of the concept, the effect of self-regulated learning toward the understanding of concepts, and describe the understanding of the concept. This research is a mixed-method with a combination model used in Sequential Explanatory Design. The subjects were fourth-grade elementary school students in the city of Singkawang. In the qualitative part, taking the subject is to randomly select 1 student from the criteria of understanding the concepts that arise. Data collection instruments used were tests and questionnaires. The data analysis technique used is the scoring, N-Gain test, simple regression test, and quantitative descriptive. The results of this study showed: (1) there is an increase in understanding of concepts in RME learning assisted by PANDU; (2) there is a significant influence between self-regulated learning and the understanding of concepts in RME learning assisted by PANDU, and (3) the understanding of concepts in learning RME assisted by PANDU has an average of 79.63.

Keywords: RME; Understanding of Mathematical Concepts; Self-Regulated Learning; PANDU

I. INTRODUCTION

The success of learning mathematics can't be separated from the ability to understand students' mathematical concepts. NCTM (2000) stated that learning with good understanding can make learning easier next. This shows that the ability to understanding mathematical concepts is basic in learning mathematics. Understanding concepts is the ability to understand concepts, operations, and relationships in mathematics (Kilpatrick et al., 2001). There are some knowledge and understanding that can be measured in the ability to understand the mathematical concept. According to NCTM (2000), students' knowledge and understanding of mathematical concepts can be seen from the ability of students to define concepts verbally and in writing, create examples and not examples and use symbols to present a concept.

According to NCTM (2000), psychological research and education about learning mathematics expressly establish that understanding concept have an important role in one's knowledge and activity skills. Not only is that, but the understanding of the concept is also needed in solving problems. NCTM (2000) stated that conceptual understanding is an important component of the knowledge needed to deal with new problems.

Facts in the field based on the results of interviews with several elementary school teachers found that understanding of concepts of students from year to year was still low, especially in the material of fraction and angle. In line with the results of Hecht and Vagi (2012) showed that the

accuracy of students in the steps used to add fractions is still poor. Fractional and angular material not only exists at the elementary level but continues to college. For that reason, having a good understanding of the concepts in this material as early as possible will greatly assist students' success in learning mathematics in the future. The low ability of understanding of mathematical concepts students is supported by the results of research Suraji, Maimunah, and Saragih (2018) which showed that students' understanding of mathematical concepts is still low, especially in applying daily life.

The ability to understand concepts is one aspect that will determine the success of learning mathematics. As mentioned by NCTM (2000) that learning with good understanding can make further learning easier. In addition to the ability to understanding mathematical concepts, self-regulated learning is also one of the aspects that determines the success of learning mathematics. The results of Sun, Xie, and Anderman (2018) showed that the importance of students' learning independence in learning in the classroom, especially in students' prior mathematical knowledge for student academic success. According to Candy (1991), learning independence is a process of someone taking the initiative, with or without the help of others, in determining their learning needs, determining their learning goals, determining their learning facilities, choosing and implementing appropriate learning strategies, and assessing their learning outcomes. This means that student awareness in learning and solving problems are part of self-regulated learning. With self-regulated learning, students can manage well how to learn because students themselves know their abilities. In line with the results of research by Ulpah and Sahly (2020) which showed that independent learning makes students trained and manage every action, so students have discipline in the learning process.

Based on the results of interviews with several teachers and students, it was found that students' self-regulated learning was still low. One of them can be seen when the teacher asks at the beginning of learning in class, most students do not have the awareness to repeat learning at home. Most students only choose questions that are easy to solve and according to the example given by the teacher. The results of Van Gog, Hoogerheide, and Van Harsel (2020) research showed that students with low scores continue to choose assignments at the lowest level of complexity and continue to choose examples. This is contrary to the expectation that self-regulated learning is an aspect that plays a role in the success of learning mathematics.

The importance of understanding mathematical concepts and students' self-regulated learning becomes an interesting focus of attention for research. Based on the facts in the field that show the low ability to understanding concepts and students' self-regulated learning, especially elementary school students who are more dominant on something real, learning based on real things is certainly preferred. Yuniati, Armiati, and Musdi (2020) stated that the need for teachers to direct students to solve the problems that are relevant to daily life. Strengthened by the American Association for the Advancement (AAAS, 1990) stated that young people can learn most easily about things that are real and can be accessed directly by their senses. This means that real-based learning can facilitate student learning. As a result, students can organize and direct their learning activities in doing work and solving problems. In line with the results of Van Gog, Hoogerheide, and Van Harsel (2020) which showed that by involving students in easy learning, learning to solve problems can give them cues that help them improve self-monitoring and self-regulation. The American Association for the Advancement (AAAS, 1990) added that with experience, they grow in their ability to understand abstract concepts, manipulate symbols, reason logically, and generalize. This means that real-based learning can facilitate students in understanding concepts.

One of the lessons that can be done especially at the elementary school level based on real things or realistic is Realistic Mathematics Education learning (RME). According to Van den Heuvel-Panhuizen and Drijvers (2020), RME characteristics position "realistic" as a dominant thing in the learning process. Based on its definition, it can be seen that with RME learning, mathematical material that abstract dominant, can be presented in a more tangible form according to students' daily lives, making it easier for students to understand the material presented. Not all real things are easy to present in the classroom. One thing that can be done is to use teaching aids in learning. Therefore, the aid of teaching aids is certainly needed to complement RME learning to make it easier to bring real things or items into the classroom.

The use of teaching aids can make it easier for elementary students to understand the concept of the material and succeed in learning. The teaching aid aims to attract and raise student awareness in trying and solving problems. According to Anggo and Arapu (2018), the use of teaching aids in mathematics learning provides an excellent opportunity to instill an understanding of students' concepts based on their awareness of why and how concepts are built and then can use awareness to solve problems. This is very useful considering elementary school is the beginning of students gaining knowledge and will be the basis in learning further mathematical material. Besides, the use of teaching aids can make a more interesting learning atmosphere. Supported by Maduna (2002) research showed that almost without exception students and teachers enjoy the use of teaching aids so that students do math assignments with confidence and great enthusiasm.

One of the materials taught in elementary school is the material of fractions and angles. The material of fractional and angles remains studied until the level of secondary education even higher education and exists in everyday life. For this reason, props will be used that can help explain the fraction and angle material. In this study, the teaching aid used was “Papan Pecahan dan Sudut (PANDU)”. PANDU is a teaching aid that is newly designed by combining two materials (fractions and angles) in one teaching aid. The PANDU teaching aids used is a board that is designed to assist in the explanation of fractional and angle material. The

Journal of Education, Teaching and Learning
Volume 5 Number 2 September 2020. Page 229-237
p-ISSN: 2477-5924 e-ISSN: 2477-4878

terms used in PANDU use terms that are common to elementary students and relate to everyday life. The terms used for fraction material are boards of pieces of fruit (dragon fruit, kiwi, strawberries, and watermelons) and for corner material which is clock rotation. The use of this PANDU teaching aid complements RME learning because not all objects are easily present in the classroom. So that the existence of PANDU teaching aids is expected to facilitate the explanation of learning materials of fractions and angles. It is expected that students will become more eager to do the assignments and practice questions independently and can understand the concepts well.

Some previous studies like that Maduna (2002), Anggo and Arapu (2018), and Yuniati, Armiati, and Musdi (2020) have used teaching aids in learning, but no one has used PANDU. It can be seen that PANDU is a newly developed teaching aid and has not yet been found to be used for mathematics learning, especially in Singkawang. So, it needs to be studied research on the ability to understanding mathematical concepts and self-regulated learning students' in the learning of RME assisted by PANDU teaching aids.

The problem in this research is: (1) is there an increase in students' understanding of mathematical concepts in learnings of RME assisted by PANDU teaching aids?; (2) is there a significant influence between self-regulated learning and the ability to understanding mathematical concepts students' in RME learning is assisted by PANDU teaching aids?; and (3) how the ability to understanding mathematical concept students' in RME learning is assisted by PANDU teaching aids? The purpose of this research is: (1) to find out the improvement in ability to understanding mathematical concepts students' in RME learning is assisted by PANDU teaching aids; (2) to find out the significant influence between self-regulated learning and ability to understand mathematical concept students' in RME learning assisted by PANDU teaching aids, and (3) to describe the ability of understanding of mathematical concepts students' in RME learning assisted by PANDU teaching aids.

The contribution that can be given from this research is to give an illustration to the teacher to use variations of learning such as the use of PANDU teaching aids in learning mathematics. Besides, it is expected to be a reference in the application of RME to the ability to understanding concepts in elementary students assisted by teaching aids by taking into account the student regulated learning. For further research, can collaborate between RME and other mathematics teaching aids and pay attention to other internal factors of students.

II. Methodology

The type in this research is the mixing method. The combination model used is a type of Sequential Explanatory Design characterized by carrying out data collection and analysis of quantitative data in the first stage followed by data collection and analysis of qualitative data in the second stage, to strengthen the results of quantitative research conducted in the first stage. The subjects of this study were 62 fourth grade elementary school students in the city of Singkawang randomly selected about the level of school accreditation that is on the same criteria.

The data collection instruments used were tests of abilities understanding of the mathematical concept and student self-regulated learning questionnaire sheets. The test questions have been tested beforehand by three experts and tested. The test of the ability to understand the mathematical concept of loading the first indicator provides examples and non-examples from a concept (problem numbers 1b and 2b), the second indicator presents concepts in various forms of mathematical representation (problem numbers 1a and 2a) and the third indicator uses, utilizes, and chooses certain procedures or operations (problem numbers 1c and 2c) (NCTM, 2000). The self-regulated learning questionnaire sheet was developed based on several indicators, that have confidence, responsibility about assignments can get the results of learning from his own experience, has its initiative to study, able to make decisions, and like to competent (Candy, 1991). Then the self-regulated learning questionnaire was tested by three experts.

The data analysis technique used is the ability and independence scoring and then given an assessment, ability of understanding was tested with N-Gain, a simple regression test was conducted for self-regulated learning and ability of understanding concepts, and do quantitative descriptive of the ability to understand concepts. For a description of the ability of concept understanding, one student is chosen randomly from each of the criteria for understanding the emerging concepts.

III. Results and Discussion

The results of the application of RME learning assisted by the PANDU teaching aids went well. PANDU teaching aids are used during apperception, material explanation, and sample problems. The teacher uses the board of pieces of fruit on PANDU to explain the shapes of the fraction pieces and the size of the angles formed by the clockwise, addition, and subtraction operations of fractional material and angles. The teacher gives problems to students related to the concepts of fractions and angles; The teacher explains, guides and directs students to discover the concepts of fractional forms, addition and subtraction operations of fractional material and angles; students solve everyday life problems related to the concept of fractional material and angles; the addition and reduction operations of individual fractional and angular matter using their methods; form groups of 2 students (in pairs), then students compare and discuss answers with their groups; and Finally the answers are compared and discussed during class discussions. PANDU teaching aids and their implementation in class are presented in Fig. 1.

The results of the first research and data analysis showed that there was an increase in the ability to understanding mathematical concepts students' in RME learning assisted by PANDU teaching aids. The results of the ability of understanding mathematical concept students' have an average pre-test of 47.65 and a post-test of 79.63. The average of N-Gain value obtained by 0.63 is in the criteria of

Journal of Education, Teaching and Learning
Volume 5 Number 2 September 2020. Page 229-237
p-ISSN: 2477-5924 e-ISSN: 2477-4878

medium increase. A summary of the results is presented in Table I. The data on the results of increasing students' understanding of mathematical concepts in the form of N-Gain data is presented in Table II.

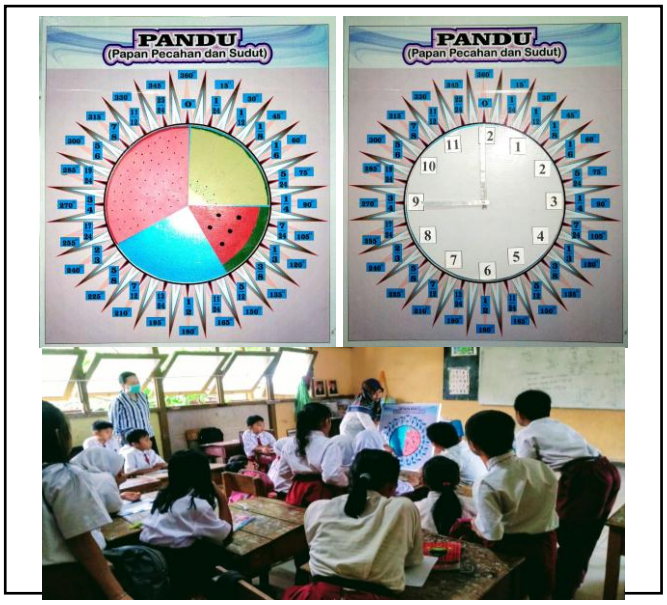

Fig. 1 PANDU Teaching Aids and Their Implementation in the Classroom

TABLE I
RESULTS OF AVERAGE OF N-GAIN

Average		N-Gain	Category
Pre-test	Post-test		
47.65	79.63	0.63	Medium

TABLE II
MANY STUDENTS BASED ON N-GAIN CRITERIA

No	Range	Criteria	Many Students
1	$g \geq 0.7$	High	15
2	$0.3 < g < 0.7$	Medium	45
3	$g \leq 0.3$	Low	2

Based on the data obtained in Table I, overall there is an increase in the ability to understand mathematical concept students'. This increase can be seen from the average pre-test and post-test data obtained. After students take part in RME learning assisted by PANDU teaching aids, many students are enthusiastic to work on sample problems in front of the class (about 90%) and many students express their opinions when learning mathematics in class (about 80%). In other words, it can be concluded that there is success in learning mathematics through RME learning assisted by PANDU teaching aids. The success of learning mathematics is inseparable from the ability to understand mathematical concepts. In line with NCTM (2000) stated that learning with good understanding can make further learning easier. This means that students' understanding of the mathematical concept will be better. So the students' mathematical concept understanding ability becomes better. In line with the results of Purwati (2020) and Arnellis et al. (2020) showed that the use of RME can improve student learning outcomes. Strengthened by some research results according to Tamur, Juandi, and Adem (2020), Febriani and Sidik (2020), Laurens et al. (2017), Zakaria and Syamaun (2017), Arsaythamby and Zubainur (2014), Hidayat and Iksan (2015), and Lestari and Surya (2017) showed that achievements or mathematical activities for those taught using realistic mathematic education are higher than those in the control group. This can be caused by students becoming interested and enthusiastic in following RME learning assisted by PANDU teaching aids. Because the learning of RME assisted with PANDU teaching aids, the material and sample questions presented are related to daily life, and students are involved in trying to use PANDU teaching aids. In line with the results of Dickinson et al. (2011) showed that during RME learning students seemed happy to work together to solve problems and share their strategies and solutions. Supported by research results Reinhold et al. (2020) suggested that an interactive and adaptive learning environment that demands constant transition between different representations of fractions can be used to convey an elaborated concept of fractions.

Aside from RME learning, PANDU teaching aids also play a role in the learning process. Because during the learning process start to apperception, the explanation of material and example problems involve the use of PANDU teaching aids. This can be seen when using the PANDU props, Student attention becomes the focus especially when some students are asked to try to use PANDU teaching aids, almost all students volunteered to be chosen by the teacher (researcher). In line with Anggo and Arapu (2018) that the use of teaching aids in mathematics learning provides an excellent opportunity to instill an understanding of students' concepts based on their awareness of why and how concepts are built and then can use awareness to solve problems. That another thing that helped the success of the learning was the teacher's explanation in the RME learning process and the explanation of the material when using the PANDU teaching aids that were going well. As a result, students become enthusiastic about learning and can understand concepts well. In line with the results of Ahmed, A., Clark-Jeavons, A., & Oldknow (2004) the role of teachers is very important in how they introduce the use of teaching aids. This means that the better the teacher's explanation in using teaching aids, the better the understanding that students get.

In addition to a good teacher's explanation in using teaching aids, the initial ability of each student also affects the learning outcomes. Supported by Kastberg (2002) which stated that when mathematical concepts are presented to students, it tries to make sense using previous knowledge about concepts. So that the initial abilities of diverse students will produce diverse abilities. Can be seen from Table II, that the category of increasing students' ability to understand mathematical concepts varies. Some categories are low, medium, and high. It can be seen that as many as 15 students are in the high increase category, 45 students are in the medium increase category, and 2 students are in the low

Journal of Education, Teaching and Learning
Volume 5 Number 2 September 2020. Page 229-237
p-ISSN: 2477-5924 e-ISSN: 2477-4878

increase category. This shows that although students get the same learnings and teaching aids, the learning outcomes are not necessarily the same. This is supported by the research results of Ahmed, Clark-Jeavons, & Oldknow (2004) which showed that different students will engage with the same teaching aids differently depending on their initial conceptions and produce different understandings.

The results and data analysis that second show that there is a significant influence between self-regulated learning and students' conceptual understanding ability after RME learning assisted by PANDU teaching aids. Based on simple regression test calculations using SPSS, obtained the influence is around 60.1%, meaning that the ability to understanding concepts is influenced by the self-regulated of student learning by 60.1% and the rest is influenced by other variables. Significant influence is caused when students have good self-regulation of student learning, there is an awareness to try and do the problem-solving. As a result, the ability to understand students' mathematical concepts increases. As long as students follow the RME learning assisted by PANDU teaching aids, students seemed to enjoy and like the learning process and bring out the self-regulated learning such as being diligent in trying and completing assignments. This was also shown by the results of the self-regulated learning questionnaire that students who did all the math assignments given by the teacher amounted to 80%. Because students are guided to do assignments and are allowed to try PANDU teaching aids for those chosen to write the answers in front of the class. So the students' mathematical concept understanding ability becomes better. In line with the results of the study of Ahmed et al. (2013), two positive emotions (pleasure and pride) are positively related to learning independence as well as with learning achievement in a very consistent way.

Based on these results, it can be concluded that students who have good learning independence in learning mathematics will have the ability to understand mathematical concepts as well. Supported by Sun, Xie, and Anderman (2018) research results showed that the importance of students' learning independence in learning in the classroom, especially in students' previous mathematical knowledge for students' academic success. In other words, the self-regulation of student learning is increasingly high, the ability to understand students' mathematical concepts is also high. So the self-regulation of student learning is one of the variables that can have a significant influence on the variable of students' mathematical concept understanding ability.

The results and analysis of the third data show that the average value of students' mathematical concept understanding ability is 79.63. A summary of the grades obtained by students is presented in Table III.

Based on Table III, it can be seen that most students have the ability of understanding concepts on high criteria after obtaining RME learning assisted by PANDU teaching aids. This is because, the use of PANDU teaching aids in mathematics learning, it can make it easier for students to understand the concept of fractional material and the angle provided. When the material of fractions, students can see the fractional value of the pieces of fruit and perform simple addition or subtraction operations that the result can be checked using teaching aids. Likewise, the material of angle, the material explanation of the angle size is presented by clockwise rotation on the teaching aid, in each number 1 to 12 the angular shape formed is 30^o. So when performing simple addition and subtraction operations, the result can be checked immediately using teaching aids. In line with the results of Indriani's (2016) research which showed that the use of fractional cards can help the learning process in fractional material. According to the study, the use of teaching aids in this study, students can see first-hand the concepts of fractions and angles that are demonstrated. So students have a picture and understand well the concept of the material. The following will describe the ability to understand the concepts obtained by students based on the criteria obtained.

TABLE III
MANY STUDENTS BASED ON CRITERIA OF ABILITY TO UNDERSTAND MATHEMATICAL CONCEPTS

No	Range	Criteria	Many Students
1	$0 \leq x \leq 50$	Low	0
2	$50 < x \leq 75$	Medium	25
3	$75 < x \leq 100$	High	37

Modification of Akbar (2013)

Based on Table III, it can be seen that there are no students who have grades in the low criteria range. In the medium criteria, there are 25 students. In the high criteria, there are 37 students. Each student is sorted by name and then given a code A-01 to A-62. After that, each student code is described as the ability to understanding concepts based on criteria by the range column in Table III. The ability to understand concepts students' in the medium criteria that will be described is shown by A-11. The ability to understand concepts students' in the high criteria will be described as shown by A-02.

The ability to understanding A-11 students' mathematical concepts in fraction material (Question number 1 on the ability test questions) shows that the part (a), students are asked to state the problem given in the form of fractions and pie charts of each item bought. Based on the answers given, it appears that students can correctly make fractions of the given problem. However, when asked to make in the form of another representation (pie chart), some drawings are incorrect so that the answers students give are wrong. That A-11 can make several circle diagrams that are asked for problems even though there is also one that he mistakenly made in his pie chart. The existence of RME learning assisted PANDU teaching aids can give some illustrative examples to students through a board of pieces of fruits about the shape of a fraction such as $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ and $\frac{1}{6}$. So students can make a fraction of the given problem and draw the circle diagram requested.

In the part (b), students are asked to group problems that are given in the form of fractions and those that are not. The

Journal of Education, Teaching and Learning
Volume 5 Number 2 September 2020. Page 229-237
p-ISSN: 2477-5924 e-ISSN: 2477-4878

answers that students give have some correct points, but some are also wrong. That student's lack of understanding in classifying the form of fractions and those not. When given a form of fractions such as $\frac{1}{3}, \frac{1}{2}$ and so on, students answer correctly that numbers are fractions. However, he also answered that 2 is a fractional form so the answer is wrong. Students lack understanding and experience confusion when they encounter form $\frac{2}{1}$ so that they are classified as a form of fractions. The sample of student answers is presented in Fig. 2.

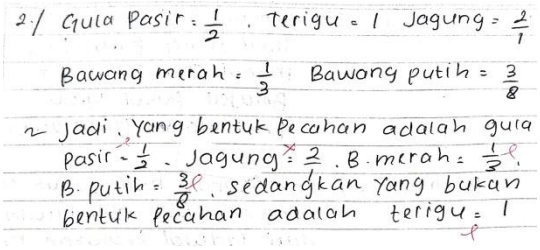

Fig. 2 Answer A-11 Number 1 Part b

In the part (c), students are asked to determine the total expenditure purchased and costs to be incurred. The answer given shows that the procedure/method used is correct, namely equating the denominator of a fraction. After an explanation of fractional operations, such as $\frac{1}{2}+\frac{1}{3}$ using a board of pieces of fruit and the results are shown in the PANDU are $\frac{5}{6}$. After doing the calculations the students' final answers turned out to be wrong. From the answers given by students, it can be seen that there was a mistake during the calculation which resulted in the wrong final answer. That students are not careful in doing calculations and are not careful in seeing numbers in questions.

The ability to understanding of mathematical concepts of students A-11 on the material of angles (Question number 2 on the ability test questions) shows that the part (a), students are asked to state the smallest angle formed by the clock problem given and make a line that forms the angle. The answers given seem that students determine the magnitude of the angle formed by 1 number on the clock. In PANDU it can be seen that the smallest angle indicated by 1 number on the hour is 30°. So students can understand the smallest angle formed at 1 number on the hour is $30°$. But he only answered so and did not continue the answer for the first part. Because the student misinterprets the problem so that the answer he gave is wrong, but he has worked on the opaque paper about the angle formed by each activity and did not move it on the answer sheet.

In the part (b), students are asked to group the problems that form 90° angles and not. The answer given turns out students can group these angles correctly. Because students already understand well in determining the angle. A sample of students' answers is presented in Fig. 3. In the part (c), students are asked to determine the total angle formed if there are two activities that they do not do. The answer students gave was to add up all the angles formed without these 2 activities and the results were correct. Because students can understand the questions well, can do the procedures correctly, and be careful in doing calculations. In line with the results of research Ilyas and Basir (2016) showed students with an intermediate conceptual understanding can apply the procedure.

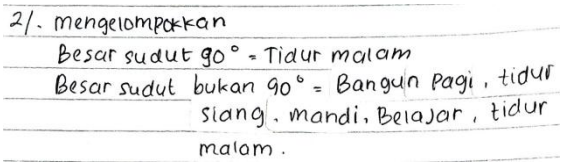

Fig. 3 Answer A-11 Number 2 Part b

Next will be described as the ability to understand mathematical concepts students A-02. The ability to understand students' mathematical concepts A-02 on the fractional material (Question number 1 on the ability test questions) shows that the part (a), students are asked to state the problem given in the form of fractions and pie charts of each item bought. The answers given are students can express in the form of fractions and draw circular diagrams correctly. With RME learning assisted by PANDU teaching aids, it can give students a few examples of illustration through the board of pieces of fruit about the shapes of fractions such as $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ and $\frac{1}{6}$.

In the part (b), students are asked to group problems that are given in the form of fractions and those that are not. The answers given appear students can write correctly the grouping of fractions and those not from the given problem. Students have a good understanding of the concept of fractions. In the part (c), students are asked to determine the total expenditure purchased and costs to be incurred. The answers are given to look at students doing the procedure of adding up the form of fractional correctly. The procedure is to equalize the denominator and then do the calculation correctly. After an explanation of fractional operations, such as $\frac{1}{2}+\frac{1}{3}$ using a board of pieces of fruit and the results are shown in the PANDU are $\frac{1}{6}$. So students can see that the denominator must be equalized. Besides, when doing calculations students have done it correctly so that they get the right answer. A sample snippet of the student's answer is presented in Fig. 4.

The ability to understand students' mathematical concepts A-02 on the material of angle (Question number 2 on the ability test questions) shows that the part (a), students are asked to state the smallest angle formed by the clock problem given and make a line that forms the angle. The answers given indicate that students can determine the angle of each of the activities and make lines that form these angles correctly. After following RME learning assisted by PANDU teaching aids properly, it can lead to the ability of students to understand the concept of the angle. Like when the explanation of the smallest angle formed by the numbers 1 and 12 is 30° and the straight line representing the forming

Journal of Education, Teaching and Learning
Volume 5 Number 2 September 2020. Page 229-237
p-ISSN: 2477-5924 e-ISSN: 2477-4878

of the angle is the needle that points to numbers 1 and 12. The sample student answer is presented in Fig. 5.

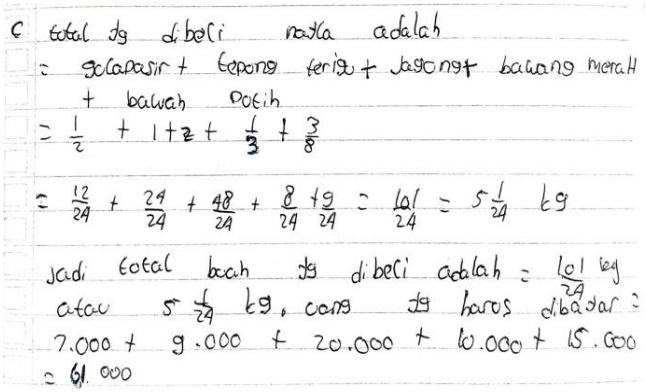

Fig. 4 Answer A-02 Number 1 Part c

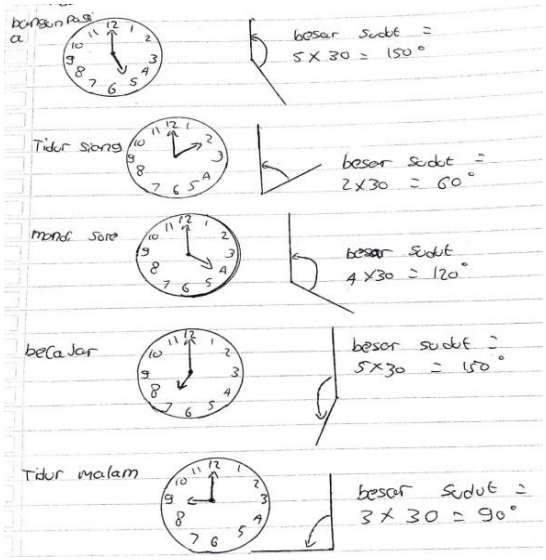

Fig. 5 Answer A-02 Number 2 Part a

In the part (b), students are asked to group the problems that form 90° angles and not. The answer given is students can answer correctly. Students have understood how to determine the magnitude of the angle formed as seen from the answers in the first part so that he easily answers the second part. In line with NCTM (2000) stated that learning with good understanding can make further learning easier. In the part (c), students are asked to determine the total angle formed if there are two activities that they do not do. The answer given is students correctly answer. Students can do the calculations correctly according to the problems given. Students have a good understanding of the given questions and can do calculations carefully.

Based on the description of students' answers on the ability to understand mathematical concepts that have been described, it can be said that students in the medium category, not quite right in giving examples and non-examples of a concept and incorrectly presents concepts in various forms of mathematical representation. While students in the high category can be in all indicators of understanding the concepts provided. In line with Yusrina, Inganah, and Putri (2020) and Kurniasi and Juwita (2019) research showed that students with high levels of understanding can meet all indicators of conceptual understanding. Kurniasi and Juwita (2019) added that there were many students with medium abilities who were wrong in the procedure.

IV. Conclusions

Based on the description above, several conclusions are obtained. The first conclusion that is there is an increase in understanding of mathematical concepts of students' in learning RME assisted by PANDU teaching aids as indicated by the average N-Gain is in the medium criteria. The second conclusion that is there is a significant effect of students' self-regulated learning toward the ability to understand mathematical concepts. This means that the ability to understanding mathematical concepts is influenced by the self-regulated learning of students'. The third conclusion is the average ability to understanding mathematical concepts students' by 79.63. There are two categories of the ability to understand mathematical concepts found, namely medium and high. Students with medium concept comprehension ability make some mistakes in answering indicators of conceptual understanding. Whereas students with high concept comprehension ability, have answered questions about indicators of understanding concepts well and correctly. Suggestions for further researchers are the need to develop other teaching aids for other materials, especially for learning mathematics in elementary school.

Acknowledgment

Our gratitude goes to STKIP Singkawang for permitting us to conduct research. Our gratitude also goes to the schools where the research was tested, both to the principal, teacher, and fourth-grade students in the city of Singkawang who were involved.

References

AAAS. (1990). *American Association for the Advancement of Science*, Project 2061, 1990.

Ahmed, A., Clark-Jeavons, A., & Oldknow, A. (2004). How can teaching aids improve the quality of mathematics education. *Educational Studies in Mathematics*, *56*(2-3), 313–328. https://doi.org/https://doi.org/10.1023/B:EDUC.0000040412.39121.e0

Ahmed, W., Van der Werf, G., Kuyper, H., & Minnaert, A. (2013). No TitleEmotions, self-regulated learning, and achievement in mathematics: A growth curve analysis. *Journal of Educational Psychology*, *105*(1), 150. https://doi.org/https://psycnet.apa.org/doiLanding?doi=10.1037%2Fa0030160

Akbar, S. (2013). *Instrumen Perangkat Pembelajaran*. PT Remaja Rosdakarya.

Anggo, M., & Arapu, L. (2018). The use of mathematics teaching aids to train metacognition ability of elementary school students. In *Journal of Physics: Conference Series*, *1028*, 012143. https://doi.org/https://iopscience.iop.org/article/10.1088/1742-6596/1028/1/012143/meta

Arnellis, A., Fauzan, A., Arnawa, I. M., & Yerizon, Y. (2020). The Effect of Realistic Mathematics Education Approach Oriented Higher Order Thinking Skills to Achievements' Calculus. In *Journal of Physics Conference Series*, *1554*, 012033. https://doi.org/https://doi.org/10.1088/1742-6596/1554/1/012033

Arsaythamby, V., & Zubainur, C. M. (2014). How a realistic mathematics educational approach affect students' activities in primary schools. *Procedia-Social and Behavioral Sciences*, *159*, 309–313. https://doi.org/https://doi.org/10.1016/j.sbspro.2014.12.378

Candy, P. C. (1991). *What is Self-Directed Learning, in Self Direction for Longlife Learning*. Jossey-Bass.

Dickinson, P., Hough, S., Searle, J., & Barmby, P. (2011). Evaluating the impact of a Realistic Mathematics Education project in secondary schools. *Proceedings of the British Society for Research into Learning Mathematics*, *31*(3), 47–52. https://bsrlm.org.uk/publications/proceedings-of-day-conference/ip31-3/

Febriani, W. D., & Sidik, G. S. (2020). The Effect of Realistic Mathematics Education (RME) on the Understand Mathematical Concepts Skills of Elementary Students Using Hypothetical Learning Trajectory (HLT). *Primary Edu-Journal of Primary Education*, *4*(1), 89–99.

Hecht, S. A., & Vagi, K. J. (2012). Patterns of strengths and weaknesses in children's knowledge about fractions. *Journal of Experimental Child Psychology*, *111*(2), 212–229. https://doi.org/https://doi.org/10.1016/j.jecp.2011.08.012

Hidayat, R., & Iksan, Z. H. (2015). The Effect of Realistic Mathematic Education on Students' Conceptual Understanding of Linear Progamming. *Creative Education*, *6*(22), 2438. https://doi.org/10.4236/ce.2015.622251

Ilyas, M., & Basir, F. (2016). Analysis Of Student's Conceptual Understanding Of Mathematics On Set At Class VII SMP Frater Palopo. In *Proceeding International Conference on Mathematic, Science, Technology, Education and Their Applications*. https://ojs.unm.ac.id/icmstea/article/view/2631

Indriani, A. (2016). The Use of Fractional Cards for Fraction Learning in The Fifth Grade Students of Elementary School. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *1*(1), 28–35. https://doi.org/10.23917/jramathedu.v1i1.1783

Kastberg, S. E. (2002). *Understanding mathematical concepts: The case of the logarithmic function*. University of Georgia.

Kilpatrick, Jeremy,. Swafford, Jane,. & Findell, B. (2001). Adding It Up Helping Children Learn Mathematics. *Division of Behavioral and Social Sciences and Education National Research Council*.

Kurniasi, E. R., & Juwita, I. (2019). Analisis Kemampuan Pemahaman Konsep Matematis Mahasiswa Ditinjau dari Kemampuan Tinggi, Sedang, Rendah. *Edutainment*, *7*(1), 21–34. https://doi.org/https://doi.org/10.35438/e.v7i1.160

Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2017). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement? *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(2), 569–578. https://doi.org/https://doi.org/10.12973/ejmste/76959

Lestari, L., & Surya, E. (2017). The Effectiveness of Realistic Mathematics Education Approach on Ability of Students' Mathematical Concept Understanding. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, *34*(1), 91–100. https://www.gssrr.org/index.php/JournalOfBasicAndApplied/article/view/7545

Maduna, M. J. (2002). *An analysis of the use of teaching aids and the implications for teaching and learning mathematics in Qwaqwa phase one schools*. [Concordia University]. https://spectrum.library.concordia.ca/1844/

NCTM. (2000). *Principles and Standarts For School Mathematics*. NCTM.

Purwati, R. (2020). Application of Realistic Mathematic Education (RME) Approach in learning Mathematic to Improve Student Learning Outcomes. In *International Conference on Elementary Education*, 729–736. http://proceedings2.upi.edu/index.php/icee/article/view/681

Reinhold, F., Hoch, S., Werner, B., Richter-Gebert, J., & Reiss, K. (2020). Learning fractions with and without educational technology: What matters for high-achieving and low-achieving students? *Learning and Instruction*, *65*, 101264. https://doi.org/https://doi.org/10.1016/j.learninstruc.2019.101264

Sun, Z., Xie, K., & Anderman, L. H. (2018). The role of self-regulated learning in students' success in flipped undergraduate math courses. *The Internet and Higher Education*, *36*, 41–53. https://doi.org/https://doi.org/10.1016/j.iheduc.2017.09.003

Suraji, S., Maimunah, M., & Saragih, S. (2018). Analisis Kemampuan Pemahaman Konsep Matematis dan Kemampuan Pemecahan Masalah Matematis Siswa SMP pada Materi Sistem Persamaan Linear Dua

Variabel (SPLDV). *Suska Journal of Mathematics Education*, *4*(1), 9–16. https://doi.org/10.24014/sjme.v3i2.3897

Tamur, M., Juandi, D., & Adem, A. M. G. (2020). Realistic Mathematics Education in Indonesia and Recommendations for Future Implementation: A Meta-Analysis Study. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *4*(1), 17–27. https://doi.org/https://doi.org/10.31764/jtam.v4i1.1786

Ulpah, M. & Sahly, M. . (2020). No TitleThe Effect of Reciprocal Teaching Model on Students' Self-Regulated Mathematics Learning in SMPN 2 Patikraja Banyumas Regency. In *Proceeding International Conference on Science and Engineering*, 585–588. http://sunankalijaga.org/prosiding/index.php/icse/article/view/569

Van den Heuvel-Panhuizen, M., & Drijvers, P. (2020). Realistic mathematics education. *Encyclopedia of Mathematics Education*, 713–717. https://doi.org/https://doi.org/10.1007/978-3-030-15789-0_170

van Gog, T., Hoogerheide, V., & van Harsel, M. (2020). No TitleThe Role of Mental Effort in Fostering Self-Regulated Learning with Problem Solving Tasks. *Educational Psycology Review*, 1–18. https://doi.org/https://doi.org/10.1007/s10648-020-09544-y

Yuniati, B. Y., Armiati, A., & Musdi, E. (2020). The influence of realistic mathematics education (RME) approach with the TANDUR on understanding the concepts and solving mathematical problems on grade 8 in smp negeri 1 pantai cermin. In *Journal of Physics: Conference Series*, *1554*, 012063. https://doi.org/10.1088/1742-6596/1554/1/012063

Yusrina, M. L., Inganah, S., & Putri, O. R. U. (2020). Analysis Of The Level Of Understanding Concepts And Critical Thinking Ability Of Students In Resolving Trigonomic Equations Using Graphs. *MEJ (Mathematics Education Journal)*, *4*(1), 71–85. https://doi.org/https://doi.org/10.22219/mej.v4i1.11472

Zakaria, E., & Syamaun, M. (2017). The effect of realistic mathematics education approach on students' achievement and attitudes towards mathematics. *Mathematics Education Trends and Research*, *1*(1), 32–40. https://doi.org/10.5899/2017/metr-00093