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Submission date: 30-Dec-2022 10:16AM (UTC+0700)
Submission ID: 1987390139
File name: ability_in_solving_HOTS_questions_review_from_self_effi-cacy.pdf (484.66K)
Word count: 5239
Character count: 28071

Analysis of Student Representation Ability In Solving HOTS Questions Review From Self Efficacy

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Abstract. HOTS questions are important questions given to students so that they can solve them well. The HOTS question is a form of question that will be tested on a minimum competency assessment. The representation ability of students in solving HOTS questions is very diverse, this is caused by several factors, one of which is self-efficacy. This study aims to analyze students' representational abilities in solving HOTS questions in terms of self-efficacy. The type of research used is descriptive qualitative with a case study approach. The subjects of this study were 3 students with high, medium, and low self-efficacy. Collecting data through self-efficacy questionnaires, HOTS test questions and interviews. The results showed that: (1) Subjects with high self-efficacy were able to express mathematical ideas using all representational abilities including answering questions with words by stating known, asked, and complete and precise steps, presenting pictures according to the context problems, and express problems by making mathematical symbols. (2) Subjects with medium self-efficacy can express mathematical ideas by using all representational abilities but not yet perfect including stating known, asked, and steps using words, presenting pictures but not yet correct, and stating problems by making mathematical symbols but still an operating error occurs. (3) Subjects with low self-efficacy are less able to express mathematical ideas using all representational abilities including difficulties in answering questions with words, pictures, and mathematical symbols.

INTRODUCTION

In July 2013, the Ministry of Education and Culture has implemented the 2013 Curriculum in schools in stages [1]. The implementation of the 2013 Curriculum includes the improvement of planning, implementation and evaluation of learning in accordance with Government Regulation Number 65 of 2013 concerning Process Standards which explains that the learning process in educational units is carried out in an inspiring, interactive, fun, motivating and challenging way for students to participate actively and provide a forum sufficient for creativity, initiative, and independence in accordance with the physical, psychological, talents and interests of students [2].

In the 2013 curriculum, most of the math questions are HOTS type which aims to train students in thinking at the level of analysis, creation, and evaluation [3][4]. HOTS (Higher Order Thinking Skill) type questions are questions that require students to have high-order thinking skills by involving the reasoning process in order to hone critical, creative, reflective, logical, and metacognitive thinking skills. according to Saraswati & Agustika (2020) that the important thing to do is to train students to work on math problems with the HOTS type, so that they can follow the development of 21st century knowledge and technology and increase the ranking of Indonesian students in *PISA* (*Program for International Student Assessment*) [6] [7].

Based on the results of PISA Indonesia in 2018 in the category of indonesian mathematical ability is ranked 71 out of 73 countries [7][8]. From the pisa results it is known that the position of Indonesian students is still located at the bottom level. In line with research Andri (2017) states that student achievement in mathematics is low. One of the factors causing the low achievement of students is the mathematical ability of students. According to the National Council of Teachers of Mathematics (NCTM) there are five mathematical abilities that students must master when learning mathematics, one of which is the ability to represent mathematically [10][11]. Mathematical representation

ability is one of the important skills to be considered in learning mathematics [12]. This is because the ability to represent can help communicate mathematical ideas from abstract to concrete [13][14].

Based on the facts on the ground and the results of observations with teachers at SDN Legokulon 1 Kasreman at the time of the Class 1 Teaching Campus it is known that the value of Mininimal Completion Criteria (KKM) is still low, namely 65 and the number of students who meet KKM is also still not comprehensive.This is because students in solving problems are less able to represent mathematical ideas such as verbal to symbols, verbal to images, images to symbols.So this problem is what makes students unable to solve problems well.This is in line with the results of the study Panduwinata (2019) which explains that students have difficulties in mathematical representation such as changing information from verbal to algebraic, visual to algebraic, and difficulties in using mathematical expressions.

In addition to the ability of student representation in solving problems, aspects of student psychology are also important in math learning. One such psychological aspect is self efficacy. Self efficacy is a student's belief in his or her ability to organize and complete tasks used to achieve certain results [16][17]. With a high sense of self efficacy in students are expected to succeed in solving HOTS problems.Therefore, the ability of mathematical representation of students in solving HOTS problems, further research is needed in order to know the ability of mathematical representation of students with different self efficacy.Based on the description described above, the solution that needs to be done in solving the problem is the need for an in-depth study of the ability of student representation in terms of self efficacy. Therefore, researchers are interested in conducting research with the title "Analysis of Student Representation Ability in Solving HOTS Problems Reviewed from Self Efficacy". This research can provide innovation for teachers in carrying out the learning process to be able to develop student representation skills

METHOD

This research is a descriptive qualitative research with a case study approach. This research was conducted on June, 2021. The subjects of this study were fourth grade students at SDN Legokulon 1 Kasreman, East Java, Indonesia with 3 out of 6 students taken. The technique of taking the subject of this research is a non-probability sampling technique using purposive sampling technique. The subjects of this study were grouped into three, namely 1 student with high self-efficacy, 1 student with medium self-efficacy, and 1 student with low self-efficacy according to the results of the self-efficacy questionnaire and teacher recommendations. There are three types of data collection techniques in this study, namely questionnaires, tests, and interviews. So that the research instrument used is also of three types, namely a self-efficacy questionnaire in accordance with Bandura's theory, a test in the form of HOTS questions, and interview guidelines to determine students' representational abilities in solving HOTS questions [18]. The data analysis technique in this study has three stages, namely the data reduction stage where the researcher selects and sorts the data according to the research objectives, the data presentation stage by presenting the results of tests and interviews in text, and the data verification stage or drawing conclusions. The following is a test instrument in the form of HOTS questions that are used as follows: *"Cellyn makes a family photo frame that will be pasted onto .-sized cardboard 20cm × 30cm. On the left, right, and top of the photo, there is a 2 cm wide cardboard left and the wrapping paper will wrap around the photo. If the photo and cardboard are congruent, then what is the surface area of the photo frame covered with wrapping paper?".*

RESULT AND DISCUSSION

Based on the results of the self-efficacy questionnaire, three categories were obtained, namely students with high self-efficacy, students with medium self-efficacy, and students with low self-efficacy, which can be presented in table 1 as follows.

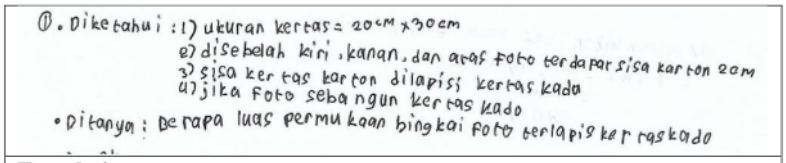
Table 1. Grouping of Students according to the results of the self-efficacy questionnaire

Category *Self Efficacy*	Many Students	Presentation
Self Efficacy hight	2	33
Self Efficacy medium	3	50
Self Efficacy low	1	17
Total	6	100

Based on table 1, the selection of the subject of this study was taken by one student in each self-efficacy category with the highest score and the teacher's recommendation to be analyzed in depth about students' representational

abilities in solving HOTS questions. The test in the form of HOTS questions was given to three selected students. The following are student test results in solving HOTS questions

Student Representation Ability with High Self Efficacy



Translation:

Is known: s

1. Paper size = 20cmX30cm
2. On the right, on the left, on the top of the photo, there are leftover cardboard = 20cm
3. the rest of the cardboard is covered with wrapping paper
4. if the photo is like wrapping paper

Asked: What is the surface area of a photo frame covered with wrapping paper?

Figure 1. Students' answers with high self-efficacy on indicators of verbal ability

On indicators of verbal representation ability, students with high self-efficacy can answer questions using written words or text. In analyzing information on the problem and evaluating the intent of the problem, students with high self-efficacy can state what is known and asked using words in full and precisely. In understanding how to solve problems, students with high self-efficacy can also write down the steps used in sequence, complete, and precise. This is in accordance with the research Nurdiana (2018) states that students with high self-efficacy can write down what is known and asked completely and clearly and the steps used to solve the problem are coherent, precise, and given reasons why using this method.

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with high self-efficacy as follows:.

$P(5)$	:	*Then, what information is asked in the question?*
$S_1(5)$	:	*Finding the surface area of a photo frame covered with wrapping paper*
$P(6)$	:	*Okay. If I ask what is the shape of the cardboard and photos?*
$S_1(6)$	:	*Rectangle, mam*
$P(7)$	:	*Why is it a rectangle?*
$P(9)$	:	*Okay, from the concept you understand. How many steps do you use when working on the problem?*
$S_1(9)$	:	*Erm... five mam*
$P(10)$	:	*Mention the steps!*
$S_1(10)$	:	*First, create an image.* *Second, determine the size* *Third, determine the area of the cardboard using the rectangular formula* *Fourth, determine the area of the photo with the rectangular formula as well.* *Fifth, determine the surface area of the photo frame by reducing the area of the cardboard and the photo area.*

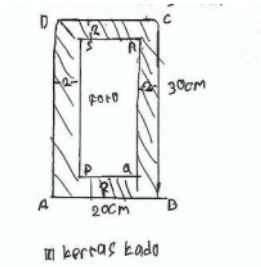


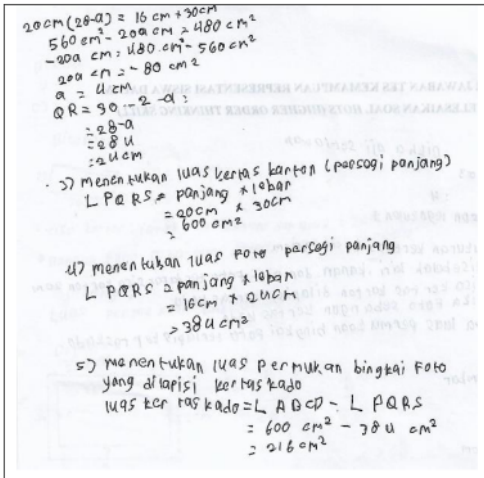
Figure 2. High self-efficacy students' answers on the drawing ability indicator

On indicators of image representation ability, students with high self-efficacy can present images of previously obtained information to solve problems. Students with high self-efficacy can display a picture of the photo frame and build a combination of right-elbow and rectangular triangles and complete with size and captioning. This is in accordance with the research Nurdiana (2018) states that students with high self-efficacy can make pictures that are able to facilitate problem solving because they clarify the problem in detail, complete and are accompanied by explanations.

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with high self-efficacy as follows:.

$P(11)$	*How did you make the picture?*
$S_1(11)$	*First draw a cardboard rectangle with a length smaller than the width and I assume ABCD. The second draws a photo that is congruent with the cardboard and is in the middle of the cardboard with for example the PQRS points. Third, write down the size of each side based on the known. Fourth shading the inside of the cardboard but outside the photo, which is the photo frame that will be covered with wrapping paper.*

2) Menentukan ukuran • kertas karton (ABCD) AD = 20cm BC = 30 cm • foto PQRS PQ: 20 cm 2 − 2 = 16 cm QS = 30 − 2 − a = 28 − a karena foto sebangun dengan kertas kado maka. $\frac{AB}{DC} = \frac{PQ}{QR}$ $\frac{20\,cm}{30\,cm} = \frac{16cm}{28-a}$	**Translation:** 2. Determine size Paperboard $AD = 20cm$ $BA = 30cm$ Picture PQRS $PQ = 20 - 2 - 2 = 16cm$ $QS = 30 - 2 - a = 28 - a$ $\frac{AB}{AD} = \frac{PQ}{QS}$



$$\frac{20}{30} = \frac{16}{28-a}$$

$$20(28-a) = 30x16$$

$$560 - 20a = 480$$

$$-20a = 480 - 560$$

$$-20a = -80$$

$$a = 4cm$$

$$QR = 30 - 2a$$

$$= 28 - a$$

$$= 28 - 4$$

$$= 24cm$$

3. determine the area of the cardboard

$$L.PQRS = length\ x\ width$$

$$= 400cmX30cm$$

$$= 600cm^2$$

4, determine the area of a rectangular photo

$$L.PQRS = length\ x\ width$$

$$= 16cm\ x\ 240cm$$

$$= 384cm^2$$

5, determine the surface area of the photo frame covered with wrapping paper

The area of wrapping paper

$$= L\ ABCD - L\ PQRS$$

$$= 600cm^2 - 384cm^2$$

$$= 216cm^2$$

Figure 3. Students' answers with high self-efficacy on the symbol ability indicator

On indicators of symbol representation ability, students with high self-efficacy apply the way of completion by creating mathematical symbols. Mathematical symbols are used by permissive size on ABCD cardboard paper and PQRS photos, while also using mathematical symbols such as variables *a* and *x*. This is in accordance with the research Setyawati (2020) states that students with high self-efficacy can use mathematical symbols by making models or mathematical equations according to the problem and are able to operate correctly.

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with high self-efficacy as follows:.

$P(12)$: *How do you determine the size?*

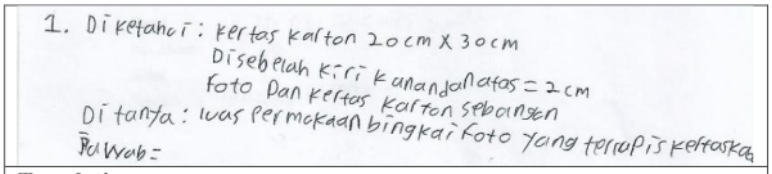
$S_1(12)$: *I make an example, where the cardboard is a rectangle ABCD with length AB = 20cm and width BC = 30 cm, while the photo is a rectangle PQRS with length PQ=16 cm and width QR=28-a.*

$P(13)$: *What is the mathematical model?*

$S_1(13)$: *Because cardboard and photos are congruent, I use comparisons. AB:BC=PQ:QR then when all sizes are entered and cross-classified to 20(28-a)=16×30 simplified to 560-20a=480 simplified to -20a=80 and found a value of 4 cm*

In general, subjects with high self-efficacy already meet all indicators of mathematical representation ability, namely indicators of verbal representation ability, image representation ability, and symbol representation ability. This is in accordance with the research Pratiwi (2019) states that students with high self-efficacy have relatively good abilities in understanding the context of the questions, so they are able to present them in the form of verbal, symbolic, and visual representations. In line with opinion of Nadia (2017) who explained that high self-efficacy students were able to use all indicators of mathematical representation ability to determine problem solving by expressing mathematical ideas into a form of mathematical representation. This is because students with high self-efficacy have characteristics that feel confident in solving problems, believe in their own abilities, and consider difficulties as challenges so that they can think focused in determining strategies in dealing with difficulties [23].

Student Representation Ability with Medium Self Efficacy



Translation:
Known: Paper size = 20cm x 30cm
On the right, on the left, on the top of the photo, there are leftover cardboard = 20cm if the photo is like wrapping paper
Asked: What is the surface area of a photo frame covered with wrapping paper?

Figure 4. The student's answer of self-efficacy is on the indicator of verbal ability

On indicators of verbal representation ability, students with medium medium self-efficacy can answer questions using written words or text. In analyzing information on the problem and evaluating the intent of the problem, students with medium self-efficacy can state what is known and asked using words but incomplete. In understanding how to solve problems, students with self-efficacy are able to write down the steps used according to the intent of the problem but not in detail and, structured and complete. This is in accordance with the research Nurdiana (2018) states that students with self-efficacy are able to write down what is known and asked but not complete and the steps used to solve the problem are correct in accordance with the purpose of the problem, but there are still miscalculations so that the final result of completion is not appropriate..

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with medium self-efficacy as follows.

$P(4)$	*Well, let's discuss question number 1 first, mention what information is in the question!*
$S_2(4)$	*It is known that the cardboard is 20 cm x 30 cm, on the left, right, and top 2 cm, the photo and the cardboard are similar*
$P(5)$	*Then, what information is asked in the question?*
$S_2(5)$	*The surface area of the photo frame covered with wrapping paper*
$P(9)$	*Okay, from the concept you understand. What steps did you use to solve this problem?*
$S_2(9)$	*The first is to make an image, the second is to make a size example, the third is to find the value of the variable s to determine the width of the photo, the fourth is to find the area of the cardboard, and the fifth is to find the area of the photo.*

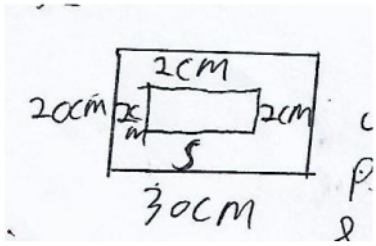


Figure 5. The student's answer of medium self-efficacy is on the drawing ability indicator

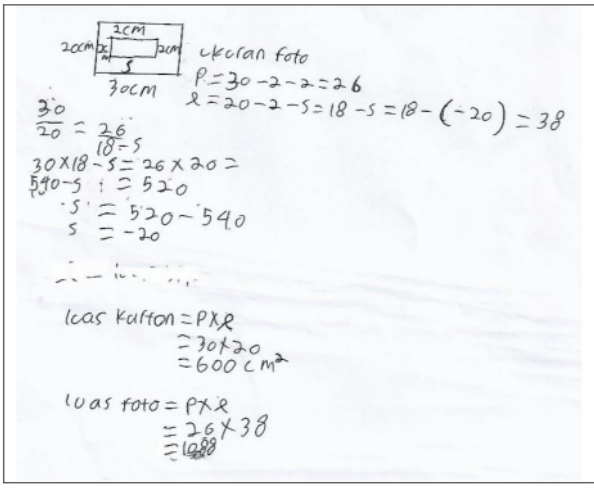
On the indicator of image representation ability, students with medium self-efficacy can present images of previously obtained information to solve problems. Subjects with medium self-efficacy can display a picture of the photo frame and build a combination of a right triangle and rectangle that is already with the context of the problem

but is less clear because there is no caption. This is in accordance with the research Nurdiana (2018) states that students with medium self-efficacy can make pictures according to the context of the questions but they are not neat, perfect and there is still information from the picture that is not clear [19][24].

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with medium self-efficacy as follows.

$P(10)$: *How did you make the picture?*

$S_2(10)$: *Erm... I drew a rectangular cardboard and for the photo I put it in a rectangular paper as well. After finishing drawing I write down the size and description according to what is known*



Translation:

Photo size

$p = 30 - 2 - 2 = 26$

$l = 20 - 2 - s = 18 - s = 18 - (-20) = 38$

$$\frac{30}{20} = \frac{26}{18 - s}$$

$$30x18 - s = 26x20$$

$$590 - s = 520$$

$$s = 520 - 590$$

$$s = -20$$

$carton\ area = p\ x\ l$

$= 30x20$

$= 600cm^2$

$photo\ area = p\ x\ l$

$= 26x38$

$= 988cm^2$

Figure 6. The student's answer of medium self-efficacy is on the indicator of symbol ability

On indicators of symbol representation ability, students with self-efficacy are in applying a way of solving by creating mathematical symbols. Mathematical symbols are used by permissive the size of the bottom of an unknown photo using the variable s. With variables so that mathematical equations appear, students with self-efficacy are experiencing operating errors so that mathematical equations are less precise. This is in accordance with the research Pratiwi (2019) states that students with medium self-efficacy have difficulty in presenting back into visual form into symbols and verbal into symbols. Agree with opinion Setyawati (2020) who explained that medium self-efficacy students were able to make mathematical models but were less able to solve problems involving mathematical expressions.

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with medium self-efficacy as follows.

$P(11)$: *Okay. How do you find the variable s?*

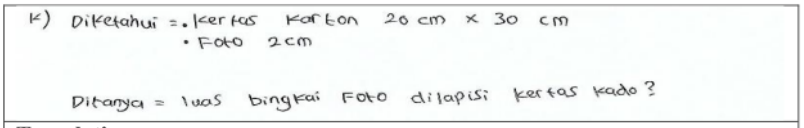
$S_2(11)$: *Since cardboard and photos are congruent, I use comparisons*

$P(12)$: *What is the mathematical model?*

$S_2(12)$: $30 \times 18 - s = 26 \times 20$ *simplified to* $540 - s = 520$ *simplified to* $s = -20$

In general, subjects with medium self-efficacy have fulfilled all indicators of mathematical representation ability, namely indicators of verbal representation ability, image representation ability, and symbol representation ability even though there are still errors. This is in accordance with the research Nadia (2017) explained that students with medium self-efficacy were able to use all indicators of mathematical representation ability even though their use was still not optimal. Agree with opinion, students with self-efficacy are having difficulty in solving problems, so the final result of completion is incomplete and inappropriate [25]. So, according to Setyawati (2020) explained that students with moderate self-efficacy had moderate representational abilities.

Representation Ability of Students with Low Self Efficacy



Translation:
In knowns :
Papperboard 20cm x 20cm
Picture : 2cm
Asked photo frame area covered with wrapping paper?

Figure 7. Students' self-efficacy answers are low on indicators of verbal ability

On indicators of verbal representation ability, students with low self efficacy can answer questions using written words or text. In analyzing information on the problem and evaluating the intent of the problem, students with low self efficacy were less able to state what was known and asked using words in full. In understanding how to solve problems, students with low self efficacy are also less able to write down the steps used according to the intent of the problem in detail, structured and complete. This is in accordance with the research states that students with low self-efficacy are incomplete in writing down what is known and asked and writing down the steps used to solve the problem is not in accordance with the intent of the question so that the solution is not appropriate [19][17].

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with low self-efficacy as follows:.

$P(5)$: *Well, it's okay, let's talk about number 1 first, let's try to mention what information is in the question!*

$S_3(5)$: *It is known that the size of the cardboard is 20 cm x 30 cm and the photo is 2 cm*

$P(12)$: *Okay, from the concept you understand. What steps did you use to solve this problem?*

$S_3(12)$: *I draw cardboard and photos first, then find the area of the photo cardboard ma'am*

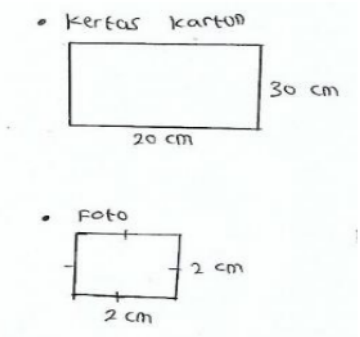
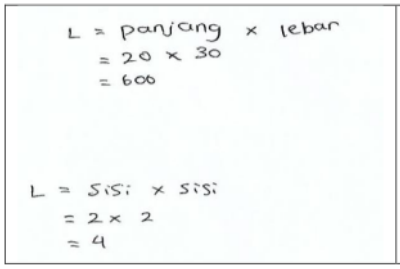


Figure 8. Students' answers with low self-efficacy on the drawing ability indicator

On indicators of image representation ability, students with low self efficacy can present images of information obtained but not in accordance with the context of the problem. Students with low self efficacy display a picture of the photo frame and build a combination of a right triangle and rectangle that is already with separate context and clear description. Nurdiana (2018) states that students with low self-efficacy can make pictures but are not accompanied by information and are not in accordance with the intent of the question.

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with low self-efficacy as follows.

$P(13)$: *How did you make the picture?*
$S_3(13)$: *I drew the cardboard in the shape of a rectangle and there was a size. If the photo is square and there is a size too*
$P(14)$: *So the cardboard drawing and the photo are separate?*
$S_3(14)$: *Yes ma'am*



Translation:
$L = panjangXlebar$
$= 20x30$
$= 600$

$L = sisiXsisi$
$= 2x2$
$= 4$

Picture 9. Students' answers with low self-efficacy on the symbol ability indicator

On indicators of symbol representation ability, students with low self efficacy in applying solutions are less able to create mathematical symbols. Students with low self efficacy have not been able to engage mathematical symbols at the time of solving the problem, where the subject only uses the formula that is remembered and there is still writing the wrong formula as well. This is in accordance with the research explained that students with low self-efficacy in solving problems have not used mathematical symbols [26]. Students with low self-efficacy have not been able to achieve the indicator of symbol representation ability, where these students have difficulty solving problems from determining the steps because students forget the formulas related to the questions [27][28].

This is also reinforced by the results of interviews which can be seen in the interview quotes of students with low self-efficacy as follows.

$P(15)$: *If I ask, what is the length of the side of the photo?*
$S_3(15)$: *2 cm ma'am*
$P(16)$: *After that, how do you find the area of the photo frame?*
$S_3(16)$: *Adding up the area of the cardboard and the area of the photo*
$P(17)$: *Okay, then what about the conclusion?*
$S_3(17)$: *So, the area of the photo frame covered with wrapping paper is* $600 + 4 = 604\ cm^2$

In general, subjects with low self efficacy do not meet all indicators of mathematical representation ability, namely indicators of verbal representation ability, image representation ability, and symbol representation ability even though there are still errors. This is in accordance with the research explained that students with low self-efficacy were less than optimal in using indicators of mathematical representation ability [29], so they had difficulty in expressing mathematical ideas into a form of mathematical representation. In line with opinion that students with low self-efficacy had difficulty in solving problems due to lack of understanding of the context of the questions and unable to determine and use the form of mathematical representations in accordance with the intent of the questions [30]. Another cause is that students with low self-efficacy have characteristics that quickly feel insecure, anxious, give up, and perceive difficulties as threats so that they find it difficult to determine strategies in solving problems [23][24].

CONCLUSION

Based on the results of research that has been done it can be concluded that the ability to represent students of each category is different in solving HOTS problems. Students with high self-efficacy are able to express mathematical ideas by using the ability of verbal representations, images, and symbols appropriately. Students with moderate self-efficacy are also able to express mathematical ideas using verbal representation skills, images, and symbols even if they are not perfect. Students with self-efficacy are being able to create images but in including inappropriate size, so that it affects the next step and in the operation of mathematical equations there are still errors. Students with low self-efficacy have difficulty expressing mathematical ideas using verbal representation skills, images, and symbols.

Based on the conclusions above, there needs to be efforts in improving student representation skills. Efforts must be carried out together such as the involvement of students, teachers, and the school in order to get maximum results.

The efforts that students must make, namely students should practice solving problems using representation skills and for students with low self-efficacy should practice understanding mathematical concepts to be easy in representing information. Teachers should also support by choosing the right method, provide guidance and opportunities for students to express mathematical ideas. Efforts made by students and teachers must be supported by the school such as providing mathematical learning media that are able to improve the ability of student representation.

ACKNOWLEDGMENTS

In the completion of this study, the author received a lot of support from various parties. For that, the author expressed his gratitude to Mrs. Heny Kurniawati, S. Pd. Head of SDN Legokulon 1 Kasreman who has given research permission. Lecturer of Guidance in mathematics education department of Universitas PGRI Madiun who has provided guidance and direction, as well as students of grade IV SDN Legokulon 1 Kasreman who have been the subject of this study. Hopefully in this research it can be useful for all parties.

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