Improving Reasoning Ability of Elementary Students in Solving Mathematical Problems With The OSCAR Learning Model

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Abstract. This study aims to describe the increase in Elementary School students' reasoning ability in solving mathematical problems using the OSCAR learning model and responses students. The OSCAR model was developed by researchers in 2017. The OSCAR model based on the Problem Based Learning (PBL) model and several learning approaches such as Realistic Mathematics Education (RME) and Contextual Teaching and Learning (CTL). The difference between OSCAR and PBL lies in the Self-observation phase. This phase gives students the opportunity to observe problems individually before being discussed in groups. This model consists of five phases, namely Orientation, Self-observation, Construction, Association, and Reflection. The research used quasi experimental method with the one group pretest-posttest design. The instrument that used are mathematical problem solving test and student response questionnaire. The subject of this research is the V-B grade students of SDN Sidotopo Wetan I Surabaya in 2017/2018. To see the increase in student reasoning ability is to calculate the *N-gain* index. The calculation result of the *N-gain* reasoning score has an average 0,40. This shows an increase.The results of the analysis on students' responses showed an average of 99,66% of students happy about the subject matter, work-sheet, exercises, and how teachers teach.

1. Introduction

Mathematics and reasoning are both inseparable. "Reasoning ability is trained through mathematics learning, and mathematical material can be understood through reasoning [1]. Reasoning and proof form foundation of mathematical understanding and that learning to reason and justify is crucial for growth in mathematical knowledge" [2]. Reasoning activities are closely related to problem-solving. "Reasoning ability is required by every human being either when solving a problem or when deciding a decision" [3]. Some of the descriptions show that reasoning abilities are required not only in mathematics learning but in other activities. Reasoning is a high-level thinking. Reasoning includes basic thinking, critical thinking, and creative thinking [4]. Reasoning includes the sixth principle of the development and implementation principles of strengthening character education currently being promoted by the ministry of education and culture through the implementation of the 2013 curriculum of 2016 revision. The sixth principle is the XXI century skill, including critical thinking, creative thinking, communication skills, et all [5]. Critical thinking and creative thinking are part of the reasoning. Given the importance of reasoning ability, this ability must be trained form an early age. Reasoning ability can be trained through the process of learning in the classroom by using a model of learning that can involve, both physical and mental activity.

We developed the OSCAR learning model in the 2016/2017 before this research. The development of the OSCAR model is carried out by following the development phases of Plomp (1997). The phases consist of (1) initial, (2) design, (3) realization, (4) tests, evaluation and revision, and (5) implementation. The results of the development show that the OSCAR model is valid and feasible to use. Validity level of the average total validity is 3.32, it is a valid category. While the level of feasibility is based on the conclusions of the validators stating that the OSCAR model is appropriate to be used to train students' reasoning.

Therefore, we tried to apply the OSCAR learning model to improve the reasoning of Elementary students in solving mathematical problems.

2. The OSCAR Learning Model & Reasoning

The OSCAR learning model was inspired by the PBL model, CTL and RME approaches. In PBL, the learning approach begins by using realistic problem [6]. The application of learning by using CTL had a significant effect on the students' high-order thinking skill [7]. In RME, learning is starting from contexts that elicit students'informal reasoning [8]. The OSCAR learning model has five phases, namely Orientation, Self-observation, Construction, Association, and Reflection [9]. Each phase of the OSCAR learning model can not be separated from the logical activities. Therefore the OSCAR learning model is proper to be used to train students' reasoning.

Reason or reasoning is a process of thinking of achieving logical conclusions on relevant facts and sources [10]. Reasoning is needed in problem solving. There are five patterns of problem solving behavior on understanding the story, namely (1) Direct Translation Approach (DTA)-proficient, (2) DTA-not proficient, (3) DTA-limited context, (4) Meaning-Based Approach (MBA)-full context, and (5) MBA-Justification [11]. While male students' reasoning profiles tend to be MBA types and female students tend to DTA [12].

The theory and research results that have been described above become the basis of researchers in conducting this research.

3. Methodology

The research used quasi experimental method with the one group pretest-posttest design. The design as follows

$$O_1 \quad X \quad O_2 , \tag{1}$$

where
O_1 = pre-test,
X = treatment, learning with OSCAR model,
O_2 = post-test.

The instruments that used are a mathematical problem solving test and response questionaire. The research population is the V grade students of SD Negeri Sidotopo Wetan I Surabaya East Java Indonesia in academic year 2017/2018. The technique that use in choosing sample is cluster random sampling technique. One class randomly from population is class V-B. To see the increase in student reasoning between before and after the aplication of the OSCAR learning model is to calculate the *N-gain* index (normalized gain) score obtained by the student. The *N-gain* formula that used is formula from Hake [13] as follows

$$Responnse\ Interval = \frac{score\ of\ statement\ items}{highest\ score\ item\ statement} \times 100\% \tag{3}$$

The conclusion of student response to OSCAR learning model is based on the criteria given by [14]
0% - 20% = very weak
21% - 40% = weak
41% - 60% = enough
61% - 80% = strong
81% - 100% = very strong

4. Result and Discussion

Before learning by applying the OSCAR model, in the first meeting the students were given a pretest consisting of 3 mathematical problem solving test. Pre-test is done to find out the initial of students reasoning ability before the implementation of the OSCAR learning model. The result of the pretest is presented in Tabel 1.

Table 1: The Students' Reasoning Ability Based on the Pretest

Class	Highest Score	Lowest Score	Average	Deviation Standard
Treatment	58	3,3	28,01	18,52

Data in the Table 1 show that the average of pre-learning reasoning with OSCAR learning model is 28,01 with deviation standard 18,52. The application of the OSCAR learning model in the treatment class was conducted in three meetings. Learning is carried out in five phases, namely (1) Orientation, (2) Self-observation, (3) Construction, (4) Association, and (5) Reflection. In the orientation phase, students listen to the teacher's explanation, answer questions or solve mathematical problems given by the teacher. The teacher prepares students to learn by giving mathematical problems related to real situation experienced by students. It is in line with caracteristic of PBL. The students learn and apply content based knowledge into real world problems [15]. In the self-observation and construction phase, students received student worksheet that contain mathematical problems. Students identified what was known, what was being asked, and constructed steps for solving it individuality. The results obtained as material for discussion at the phase association.

In the association phase, students discussed in groups to complete group assignments. Students explained the reasons why using the steps they made when completing individually. Students were able to share ideas and experiences, learn collaboratively and apply content based knowledge into real world problems [15]. In this phase, students participation varied greatly. There were students who actively expressed their opinions. There were also students who only approved their friends' opinions. Learning with the OSCAR model is student-centered. Some students are dominant, while others participate rarely in the class interaction [15]. In the reflection phase, each group representative presented the results of the group discussion. Other groups responded or asked questions. At the end of this phase students made conclussion.

After learning using the OSCAR model, students were given a posttest. The result of the posttest is presented in Tabel 2.

Table 2: The Students' Reasoning Ability Based on the Posttest

Class	Highest Score	Lowest Score	Average	Deviation Standard
Treatment	100	23	55,12	19,13

Pre-test and post-test scores obtained by students after following the learning by using the model of learning OSCAR average student reasoning, gain, and N-gain are briefly summarized in Tabel 3.

Table 3: The Students' Reasoning Ability Based on the Pretest

	Pre-test	Post-test	Gain	N-gain	Interpretation of N-gain
Average	28,01	55,12	27,12	0,40	medium
Standard Deviation	18,52	19,13	10,04		

The data in Table 3 show that the average of pre-learning reasoning with the OSCAR learning model is 28,01. After learning with the OSCAR model, students'reasoning increased to 55,12. The obtained gain is 27,12. While the increase in reasoning is shown by the N-gain score of 0,40 is included in the moderate category.

The average increase of reasoning from pre-test to post-test is followed by an increase in data distribution. Standard deviation on the pre-test of 18,52 while the post-test of 19,13. This show that students' reasoning after learning with OSCAR model is more varied, although the change is only 3,29%. The average of students'reasoning is illustrated in Figur 1.

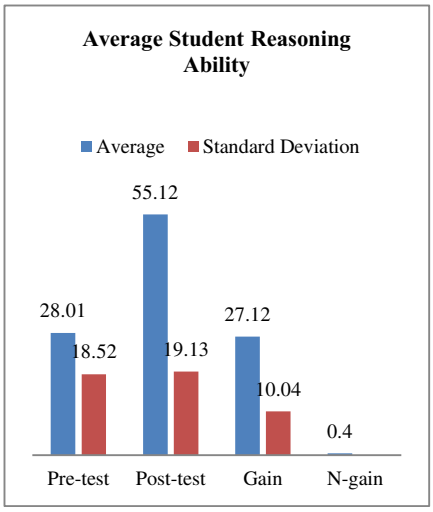

Figure 1. Average Student Reasoning

The average N-gain in the moderae category is supported by N-gain of each student. The percentage increase in students' reasoning is summarized in Table 4.

Table 4: The Percentage Increase of Students' Reasoning Ability Based Category

Category	Many Student	Percent
High	2	6,06
Moderate	26	78,79
Low	5	15,15
Total	33	100,00

The data in Table 4 show that 6,06% of students' reasoning improvement is categorized as high, 78,79% moderate category, and 15,15% including low category. In addition to describe the increase in students' reasoning ability, this research also illustrated the students' response to the learning device used in the implementation of the OSCAR learning model. Students were asked to respond to subject matter, student worksheet, exercise, and teachers teaching method. Students were asked to give feedback whether they were happy or unhappy and whether these components were new or not them. The result of student response data analysis is summerized in Tabel 5.

Table 5: The Percentage of Student Response to Instructional Devices and Teachers Teaching Method

Component	Happy (%)	Unhappy (%)	New (%)	Not New (%)
Subject Matter	98,65	1,35	70,27	29,73
Student Worksheet	100,00	0,00	85,14	14,86
Exercise	100,00	0,00	75,68	24,32
Teachers Teaching Methode	100,00	0,00	71,62	28,38
Average	99,66	0,34	75,68	24,32

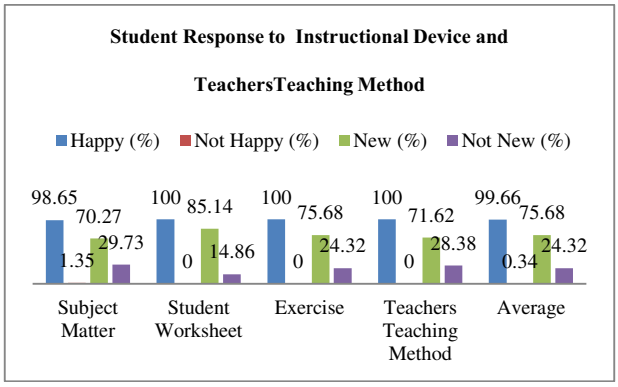

Figure 2. Student Response to Instructional Device and Teachers & Teaching Method

The data in Table 5 show that 98,65% of students were happy about the subject matter presented and all students are happy with the student worksheets, exercises, and teachers teaching method. In accordance with predeterminated criteria, students' responses to all component were very strong. This shows that students are very happy to learn by using the OSCAR learning model. As an illustration the percentage of students' responses to instructional devices and the teachers teaching method is illustrated in Figure 2. Student responses to new or not new subject matter, 70,27% of students consider the subject matter discussed was new. Meanwhile the student worksheets andthe exercises were 85,14% and 75,68% of the students respectively. While the way teachers teach, 71,62% of students consider the new. Some of the reasons given by students were (1) I could not, now I can, (2) I become more knowledgeable about math, (3) I do it easier, and (4) in this wayI can practice to besmarter.

5. Conclusion

The results of the research showed that reasoning ability for the fifth grade of elementary students in solving mathemathical problems with the OSCAR learning model is increased. The increase is including the moderate category. As many as 5,56% including high category, 72,22% moderate category, and 13,89% low category. On average 99,66% of students happy to the subject matter, worksheets, exercises, and how the teacher teaches.

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