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The Effectiveness of The Open-Ended Approach to Student Learning Outcomes

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Abstract. Mathematics is one of the important subjects learned at all levels, and mathematics must be understood by every educator and student. One of the topics learned in mathematics is fractions, and it is considered as a difficult topic. The method used in this research was pre-experiment with the type of one-shot case study. An open-ended approach was an approach used in this study to improve student learning outcomes of students. Based on the results and discussion, it was found that (1) after the application of the open-ended approach as many as 16 out of 23 students were thoroughly completed in fractions with a percentage of 70%; (2) after applying the open-ended approach as many as 18 out of 23 participants (78%) students showed active and spiritual which was very good at learning.

Keywords: Mathematics, pre-experiment, one-shot case study, fractions, open-ended, students' outcome

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INTRODUCTION

Education is an effort made consciously and systematically to make changes for the better (Hevriansyah & Megawanti, 2017) so that human quality can be developed (Fujiawati, 2016). The changes referred to here are changes from all sides of life both in terms of knowledge in the form of problem-solving, creativity, hard work (Kania, 2018) as well as in terms of behavior or behavior (Asyafiq, 2016). Education is an inseparable part of humans because education will form perfect humans, meaning that human education can carry out all forms of responsibility as a whole human being (Arfani, 2016).

Education seeks to improve the quality of every single human being through the learning process. Learning itself is the effort which is made by every man to improve and to change their behavior. Similar to this statement (Hartuti & Widyasari, 2016) revealed that learning is an act that is planned to gain knowledge and expand insight. By learning, every human being who learns will get a change in himself both in terms of the minds, and action (Nahar, 2016; Oktariska et al., 2018). The learning process is an activity that can provide a sense of tired to learners so that educators must be able to manage the learning well so that it can motivate learners in learning (Nur Fidiyanti et al., 2017) and the perfect learning is the feedback of learners (Yaşar & Akbaş, 2019).

Mathematics is one of the subjects that exist at every level of education ranging from primary school, junior high school, senior high school to college (Purnama et al., 2017) where it is an important subject in education (Damayanti & Sumardi, 2018). One of the important facts of this subject is that academic success can be achieved through this subject (Sari & Aydogdu, 2020). This statement is one of the facts that cannot be denied. On the other hand, this subject is considered as one of the difficult subjects in the elementary school including on several concepts (Sari & Olkun, 2019). In the primary school curriculum itself, mathematics is one of the compulsory subjects that must be understood by learners. It is because mathematics is one of the basic sciences (Widiartana, 2018) which has an important role in developing the science and the technology (Siagian, 2016), on the other hand, studied mathematics, learners will have the ability in a variety of things such as calculation, measurement, use of various formula (Firdaus, 2018), logic, systematic and analytical thinking, critical in responding to every problem, creative thinking, work in the team (Sholihah & Mahmudi, 2015), problem solving, and the representation of symbols (Brandt et al., 2016). Therefore, we can conclude that it is important to teach mathematics to learners. For the sake of the success of teaching mathematics to learners, educators must understand well the topic of Mathematics

(Yanti, 2018) this is because with understanding the topic well, learners will be successful in learning mathematics which in turn, it can be seen from the increasing their learning outcomes (Nurlita, 2015).

In primary school, one of the subjects which are studied in mathematics is fractions. Fractions is a number that is divided into two parts (Pertiwi et al., 2017), the first part is called the numerator, and the second part is the denominator (Badaruddin et al., 2016) which is a requirement for the students before learning other numbers (Widiastuti & Putri, 2018). This topic is a topic that is important for learners (Dyson et al., 2020) especially in their daily lives (Rodrigues et al., 2016), and it is the gateway to finding work (Tian & Siegler, 2017). Teaching this topic in elementary school is different in each level (Flores et al., 2020). Unfortunately, understanding the concept of fractions is a challenge for all students (Dougherty et al., 2015). Similar to it, Bailey et al. (2015)also said that one of the pieces of knowledge in mathematics that is elusive by learners is fractional. The same things were also expressed by Palpialy & Nurlaelah (2015) that the fraction is the difficult topic to be understood by students. Although the learners know the steps to compare the fractions, they usually do not understand the reasons behind the problem, and many of them just follow the instruction and examples that are shown to them to make the comparison (Poon, 2018).

As a first analysis, researchers conduct interviews with an educator who teaches in the classroom that is examined. Results that were found by researchers show that learners who achieve the minimum completeness criteria were 10 of 23 students with an average score of 59.2 in the topic of fractions with a percentage of 43.5%. Educators said that in conducting the learning process in the classroom, educators only used contemporary learning methods where educators only explained the topic in front of the class. By statement of teacher, we can say that the teacher has to understand the methods or approaches that they should apply in the learning process, so that the achievements of learners in learning can be improved where achievements in learning is one of the things that should be achieved by learners in schools (M. K. Nasution, 2017). Therefore, it is needed the approach that can improve the learning outcomes of the students in the subjects of mathematics, especially in the fractions.

One of the approaches which can be used as a tool to improve the ability of the learners is the open-ended approach (Triwibowo et al., 2017). The open-ended approach is a flexible method, student-centered, that has recently gained popularity in the field of mathematics education. This approach had ever been conducted in Japan, and the results of the study indicated that educators can guide students in solving problems in mathematics by using this approach (Munroe, 2015) where problem-solving itself is a part of high-level thinking skills (Brookhart, 2010).

An open-ended approach based on Shimada and Becker (1997) provides more opportunities for students to gain more understanding, experience in finding, knowing and solving problems (Fatah et al., 2016) because this approach gives participants problems. students to be solved using a variety of different methods and various solutions (Wati & Musdi, 2018) without seeing the process used in achieving these solutions (Bartholomew et al., 2018). This happens because, through this approach, students are able to bring up various ideas in their minds (Rohaeti et al., 2019), are active in the learning process, able to carry out cooperation with other students, and their courage in expressing their opinions based on the results they found (Cidrayanti et al., 2016). Time management must be understood by educators, this is because there will be many answers from students both expected and unexpected answers and all answers must be discussed together (Shimada, 1997).

The open-ended approach is a media approach to problem-solving that is used to evaluate high-level thinking skills in learning mathematics (Irawan & Surya, 2017) through activities that are following the daily lives of students (Firdaus et al., 2016). The goal is to provide improvement to students' problem-solving skills based on their abilities (Waluyo, 2018). Young & Young (2019) also said that the Open-ended approach provides a deep understanding of the topic taught to them.

Learning by using an open-ended approach will usually be started by giving the non-routine questions (Muchlis et al., 2018) and open-ended questions to learners then giving them the opportunities to find the answers from the question with various strategies and ways that they think is right (Bernard & Chotimah, 2018). Open-ended questions referred to here is the question that can be solved with different answer where the answer is the correct answer (Basir, 2018), it means that students are not required to get just one answer but various answers and how they get it (Sabar, 2017) where the open-ended question has been developed by experts that are suitable to be used in the learning process (Randles et al., 2018). The aims of giving the questions are to foster ideas of learners (Hidayat & Sariningsih, 2018) which in turn, learners will feel challenged to solve the problem (Faridah et al., 2016).

The use of open-ended questions is widely considered as one of the important topics in learning. This can provide educators the possibility of conducting effective evaluations of students' abilities and cognitive levels achieved (Anderson & Krathwohl, 2001) including the skills of students in using their thinking abilities at a higher level (de Marsico et al., 2017) such as problem-solving and critical thinking (Karo & Hasratuddin, 2016).

The first objective of this study was to determine the overall use of the open-ended approach toward improving student learning outcomes in fractional topic. The second goal of this study is to determine the activeness of students when the open-ended approach is applied.

METHOD

Type of Research

The method which is used in this research is the pre-experiment design where the research will be conducted a treatment to the students in one class, i.e. the experiment class without any control class. Because the method in this study is not a real experiment i.e. sampling is not done randomly and there is no control class, the research method in this study is called pre-experiment design (Saputri et al., 2016). There are several kinds of pre-experiment design, and one of them is the one-shot case study, that is, the treatment which is performed by the researchers in the study is only done once (Aisyah & Nurlaela, 2015).

Researchers just do once treatment in one class, i.e. the experiment class. When designing a pre-experiment study with a type of one-shot case study described, it will look like below

Table 1. *Pre-experiment design*

Subject	Pre	Treatment	Post
Group	-	X	O

(Kuntjojo, 2009).

In this study, the posttest is conducted to students at the end of learning to see the development or improvement of students' outcomes by finding the average of students' outcomes. The formula of the average

$$\bar{x} = \frac{\sum_{i=1}^{n} xi}{n}$$

Where:
$\bar{x}$ = average (learning outcomes learner)
$\sum_{i=1}^{n} x_i$ = total value (from all learners)
n = the number of data (learners)
(Furqon, 2004).

Researchers also use Microsoft Excel software to prove whether the average researcher gets right or wrong by comparing results between using manual calculations and using Microsoft Excel software. The average value of the learners' results will be analyzed by researchers to conclude the ability of learners after treatment.

Treatment that researchers mean above is a model, method or approach that researchers use in conducting research. The model, method or approach is used as a tool in the learning process in the classroom. The approach used by researchers in this study is open-ended. This approach is an approach developed in the Land of Sakura, Japan as a breakthrough in teaching mathematics by education experts (R. Nasution & Halimah, 2013). In this approach, students will be allowed to discover, recognize, and solve problems to a problem that is before them so that in turn, a deeper understanding will be gained (Rahmawati ES & Harta, 2014).

Application of Open-Ended Approach in Learning Mathematics

This approach is an approach that was made specifically in teaching mathematics subjects that were born in response to the conditions of mathematics learning that still prioritize teaching centers that only provide explanations in front of the class (Jasmaniah et al., 2015). Lestari et al. (2017) explained stages in open-ended approach that must be understood by educators in conducting learning by using this approach (a) first, providing motivation to the students and explaining the learning objective in this case the goal of studying fractions; (b) second, giving a brief explanation to the learners about the topics; (c) third, directing the students to sit in groups; (d) Fourth, giving guidance to all learners; (e) Fifth, doing the evaluation.

Students who are the subjects in this study will be given open problems or problems, known as open-ended questions. The reason open-ended questions are used by researchers, in addition to supporting the approach that researchers apply in the learning process but also because open-ended questions can foster students' mathematical creativity (Aziza, 2018). Through these questions, students can apply their

methods or strategies in answering these questions (Kwon et al., 2006) so that students will be required to think smarter (Kurniawan et al., 2018).

There are five divisions in the open-ended question

1. Short open-ended problems
   Problems or issues are more focused on how educators provide explanations to the learners about the content of the subject matter (teaching via problem-solving) by giving the questions or problems to the students to be solved.
2. Applied real-life problem
3. Problem or issue like this is done by educators by rising problems that were faced by learners in their daily lives then link it to the problems of mathematics.
4. Mathematical investigations
5. Educators will give questions or problems to learners, and educators direct them to create the possibility of correct answers which in turn, educators will ask the learners to test the answer (Jasmaniah et al., 2015).

Data collecting

To achieve the objectives of this research, i.e. to know thoroughly the use of open-ended approach towards improvement of the learning outcomes of learners in the fractions, researchers collect data that will be analyzed to determine the development of students after treatment. Therefore, researchers use the specific techniques that researchers consider necessary in collecting data. The techniques which are used by researchers to collect the data researchers are

1. Observation

Observation is very important in the lives of humans when there is no language, tool, or machine, especially (Kripalani, 2016) in other words, observation is the humans' way of exploring information (Lontz, 2016). Observation is one of the popular research tools that is used in researching in the development of the learners (Ferguson et al., 2018) where this tool is the first stage before reaching the core of the research (Hasanah, 2017).

The things that the researchers observed in research were the behavior of learners during the learning process and the implementation of the open-ended approach to students' competencies in fractions. The observation was be conducted since the learning proses begins until learning ends.

2. Test

The test is one of the tools which is used to obtain information related to the achievement of the learning process' goal where each of the questions in the test should be well made by following the objectives of the topic being taught (Wahyudi, 2010). The test itself has been used as one of the measuring instruments in the study since the late 19th century (Cohen et al., 2000).

In this study, researchers conducted the tests for learners at the end of learning. The problems and issues that researchers used in this research were open-ended questions in the form of a direct question and open-ended problems in the form of stories. The questions or problems that were given to the learners were questions and the problems that are usually encountered by students in their daily lives.

3. Interview

Besides the two data collection techniques above, researchers also conducted interviews to collect data. The interview is one technique in collecting semi-structured data (Procter & Padfield, 1998) where this method is most widely used in research (Rachmawati, 2007), this method occurs between the person interviewing and the person being interviewed in a line of sight (Hakim, 2013). In this study, researchers interviewed educators intending to obtain information about students' abilities and methods used by educators in teaching.

RESULTS

After the learning process was conducted by applying one of the approaches that were made specifically for the subjects of mathematics, i.e. open-ended approach, researchers gave the test to students to get the results of the application of the open-ended approach. In addition to conducting tests for learners, researchers also observed learners since the study began.

From the test results of students, researchers will find out how the impact of the open-ended approach to students' ability about fraction topic. In contrast to the test, the observation that researchers do is not to see an increase in student learning outcomes but the observation is done by researchers to see changes in student behavior after the application of the open-ended approach in the form of student activity in their learning and spiritual.

After researchers conducted and analyzed the results of the test, researchers found that the learning outcomes of learners in the topic of fractions experienced an increase. This can be seen from the learners' average score that showed an increase significantly. Before implementation of the open-ended approach, as many as 10 of the 23 students who achieved the minimum completeness criteria with an average score of 59.2 with a presentation of 43.5% of the overall presentation of the learners.

After the researchers applied the open-ended approach, as many as 16 out of 23 students reached the minimum completeness criteria with a 70% presentation. The average student learning outcomes after the application of this approach is 71.2. Student learning outcomes can be seen in "**Figure 1"**.

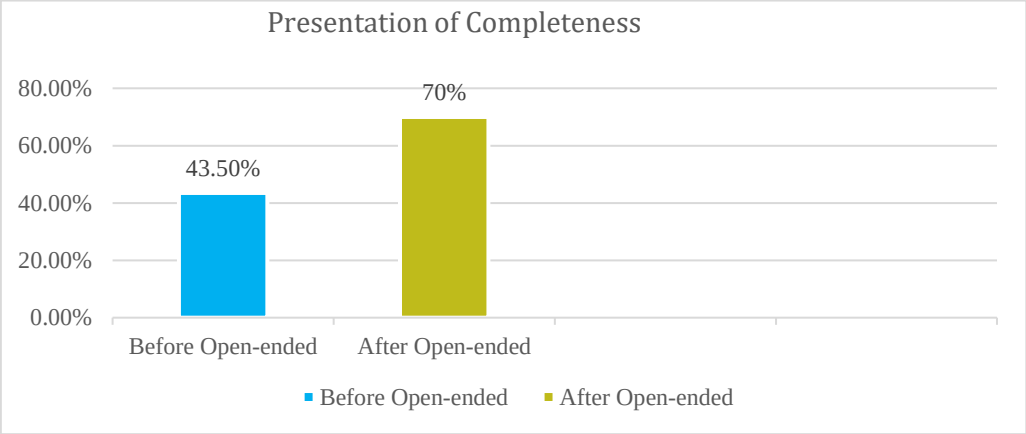

Figure 1. *Presentation of students' completeness*

From the "**Chart 1"**, we can see a significant difference between the learners' learning outcomes before the application of the open-ended approach and the learners' learning outcomes after the implementation of an open-ended approach.

In addition to testing the learners' learning outcomes, researchers also observed the students. The observation in this study was focused on the spiritual and the activeness of the learners during the process of teaching and learning. The results of the observation of learners' spiritual can be seen in the chart below.

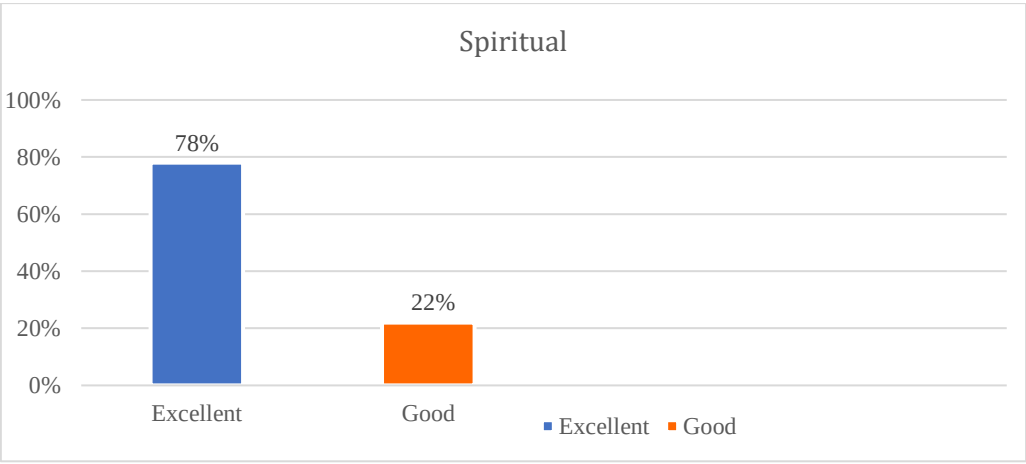

Figure 2. *Students' Spiritual*

We can see in "**Figure 2"** about the development of students' spiritual after the open-ended approach was used. As many as 18 of the 23 students with the presentation of 78% showed excellent development in the spiritual aspect. This can be seen with their enthusiastic when they were answering greetings from educators as the opening to begin the process of teaching and learning. They were also enthusiastic when they were invited by the teacher to pray both before and after learning. On the other hand, as many as 5 of the 23 students with a presentation of 22% showed good development in the same aspect.

Meanwhile, the results of observations of the learners' activeness in following the teaching and learning process in the classroom are following figure 3.

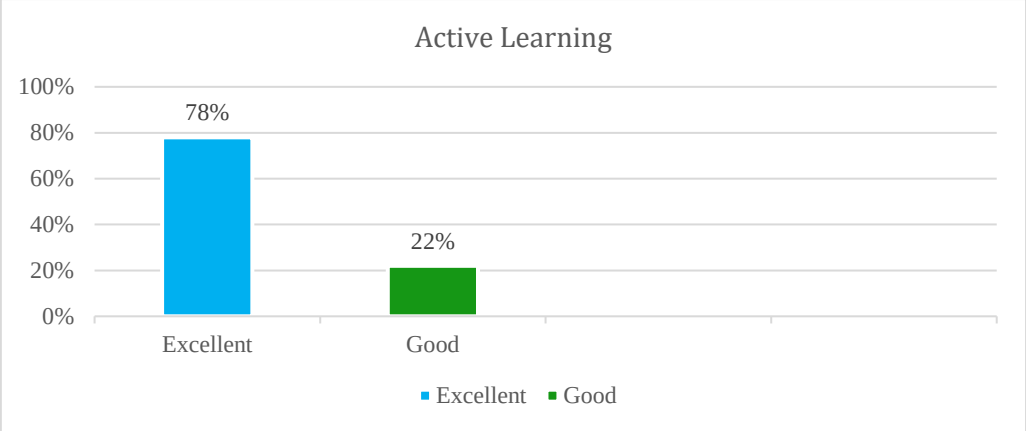

Figure 3. *Students' Active Learning*

In "**Figure 3"**, we can see the development of the learners' activity in the following lessons. Of the whole learners, i.e., 23 learners, a total of 18 learners with the presentation of the 78% showed excellent development in the aspect of the activity. It can be found with their enthusiasm in following the process of teaching and learning in the classroom, i.e. their enthusiasm in giving questions that were related to the topic, answering educator's questions, and daring to come forward to the front of the class to answer the questions or problems which were given by the educator. On the other hand, as many as 5 of the 23 students with a presentation of 22% showed a good development on the same aspects.

DISCUSSION and CONCLUSION

Open-ended Approach to Students' Outcomes

From the presented results above, it can be seen that the open-ended approach can improve the learners' outcomes. This is similar to (Firdaus et al., 2016) which stated that the approach can improve learner achievement in learning. Koriyah & Harta (2015) also revealed the same thing that the open-ended approach can affect the improvement of the students' learning outcomes.

This happens because overall students can use all their mathematical knowledge and skills in learning (Sawada, 1997). Furthermore, this approach makes students 'participation better in channeling the ideas they have (Sawada, 1997) as an open-ended approach, which is to increase students' creativity in mathematical thinking (Fitriati & Edema, 2016).

The open-ended approach gives the liberty to learners in using their capabilities both knowledge and skill that they have had before. It is similar to Shimada (1997) that the open-ended approach allows the learners to combine the whole capability that they have either skill, knowledge and their way of thinking in solving each problem that they faced. Therefore, we can say that the open-ended approach improves cognitive learners. Cognitive which researchers mean is the results of the study.

Open-ended Approach to Students' Spiritual and Liveliness

On the results of the analysis presented by the researchers above, we can see that the spiritual development of students when an open-ended approach is applied in the class shows an increase in the spiritual of students. Meanwhile, in the results of the analysis above, we can also see that the activeness of students can be improved by applying an open-ended approach. In line with the statement above, Saputra et al. (2015) also said that the application of an open-ended approach can produce classroom conditions where these conditions can create activeness, involvement, and participant motivation students so the teaching and learning process becomes better (Hidayah et al., 2016). Sawada (1997) also said that this approach can make students more actively participate in the learning process.

After the exposure results and discussion that were conducted by researchers above, we can conclude, that is (1) open-ended approach increased the learners' cognitive in this case the results of the study; (2) open-ended approach gave influence on the spiritual and the activeness of the learners in the learning process.

SUGGESTION

After the researcher presents the conclusions based on the results and discussion of the research, the researcher will present the researcher's suggestions in this study which are based on the conclusions.

Based on the research conclusions above, the researchers suggest to each teacher that an open-ended approach is an approach specifically made for teaching mathematics subjects. This approach can be used as an alternative to teaching mathematics. This approach has been tested by researchers in one school as an approach that can improve students' learning outcomes.

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