An analysis of student error types in solving mathematics problem on the implementation of osborn simple feedback learning model

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Abstract. This research aimed to find out effectiveness of Osborn Simple Feedback learning model implementation in solving mathematics problem and to analyse the error types of the students. This mix method research combined two approaches, by having sequential explanatory design (based on quantitative – qualitative orders). The population consisted of VIII graders of MTs Al – Ma’arif Rakit in academic year 2018/2019. The quantitative research side, the sample was collected through random sampling and it was gained two classes with significantly different initial problem solving. The quantitative data analysis was based on one sample t test, proportional test, and average variances of two independent sample test. The qualitative aspect of this study was done by taking the subjects based on purposive sampling. 6 students of experimental group were chosen based on their problem solving skill started from high, moderate, and poor categories. Based on qualitative analysis, it could be concluded that problem solving skill of the students was varied. It depended on the error types. The findings also showed that the implementation of Osborn Simple Feedback model was effective to problem solving skill of the students. The mathematics problem solving skill of the students on each category and research subject was varied.

1. Introduction

Mathematics problem solving skill is an important skill to have in having competitive life in this globalization era. This era demands education to create complete competency human resource, to contribute in real life, and to create thinking human resource whom could develop social and economy arrangement. International Life Skill Survey [1] stated that problem solving skill is needed by individuals to effectively involve in qualitative situation which appears in life and job. Problem solving skill becomes important part in mathematics curriculum. It is so because in learning process, students get experience based on their own knowledge and skill to solve problems which naturally are not routine [2]. Asri, Ikhsan, & Marwan [3] also stated that the content and process standards in the curriculum emphasized the importance of problem solving to own by students during learning mathematics. Since 1945, mathematics problem solving skill had become the main purpose of learning, especially since Polya published the first book discussing mathematics problem solving skill [4-6].

Even so, mathematics problem skill of Indonesian students is still considered low as the survey result of OECD 2015 shown than other countries. It was in line with Khairi, Mukhni, & Nasution [7] in SMA N 1 Akabiluru and Syazali [8] at MAN 2 Bandar Lampung who revealed that math problem...
solving skill of the student was still low. One of the causes of it was due to frequent error level done by students. Ruswati, Utami, & Senjayawati [9] stated that most of students had understood the point of the given problem and found the correct concept to be used in solving the problem. However, they still had difficulties on solving stages and calculating process. The difference of the error types done by the students made teacher to provide different solutions. Therefore, there is a need of further analysis about the error of the students. Legutko [10] revealed that in learning, teacher should analyze the error of the students to understand the error, to explain what they experience, and to find the cause of their error so that students could improve their understanding and skill.

In this research, the error was analyzed by NEA procedure. The procedure was firstly introduced by Anne Newman in 1977. The procedure covers: (1) Reading Error, (2) Comprehension Error, (3) Transformation Error, (4) Process Skill Error, and (5) Encoding Error. The procedure had been used as a reference of error type of student until now.

The problem to overcome poor level of student mathematics communication skills still becomes problem for teachers in various countries [11]. Therefore, discussion about problem solving skill is still worthy of discussing [11, 12]. Various efforts to do, one of them is improving learning quality or providing various innovation in learning [13]. Furthermore, feedback also has contributed in improving mathematics problem solving skill. As feedback functions as a monitor of student learning process which can improve achievement, develop understanding, learning ability, and motivate students by triggering and recognizing students’ efforts in learning process [14].

Suherman stated that one of ways to improve student skill, especially in problem solving is by providing problem solving skill whose various strategies [2]. Therefore, the author used Osborn model to decrease student error in mathematics problem solving. The model is a way to reconstruct thoughts to be able in sharing notions or opinion correctly. The purpose of this technique is to facilitate students in problem solving with various ways, to help them developing their thoughts during learning process, and to help in integrating students in creating relationship and assessing one to another. Learning by using this model demands students to be active in solving problem given by teachers and demands them to express ideas or notions dealing with learning materials. In this research, the model was given simple feedback to optimize the indicator achievement of mathematics problem solving skill in each learning. Simple feedback only focuses on one skill competence at a time [15]. Simple feedback consists of keyword describing completion activity and is done repeatedly during learning process. Thus, in learning, teacher repeatedly emphasized the indicators of problems solving skill to achieve.

Based on the explanation on the background, the problem formulation of the research were 1) how was the implementation of Osborn Simple Feedback to problem solving skill of the students? 2) how was the analysis of the students’ error in mathematics problem solving skill achievement? The purposes of the research were to find out effectiveness of the model in improving problem solving skill of the students and to find out the analysis of the students’ error based on NEA procedures. This research is expected to facilitate teachers in improving student problem solving skill optimally.

2. Method

This mix method research by combining two approaches – qualitative and quantitative approaches [16]. The design of the research was sequential explanatory through data collection and quantitative analysis on the first step then followed by data collection and qualitative data analysis on the second stage. The population consisted from VIII Mts Al – Ma’ruf Rakit in academic year 2018/2019. The sample was taken by simple random sampling to get the experimental and control groups. The sample consisted of 51 students from two classes. 25 students were from VIII D class as the control group while 26 students were from VIII F as the experimental group. The selection of the class was done by simple random sampling.

The research instruments were problem solving skill test and interview result. The student interview was focused on their error during answering the test. There were 6 subjects taken based on problem solving categorization: high, moderate, and poor. The techniques of collecting the data were test and interview. The interview was focused on the students’ error during answering the test. The
interview was grouped based on problem solving skill categories. The data was triangulated to ensure the validity. It was done by triangulating test and interview results then the data was analyzed by reducing the data. The data reduction was done by classifying the result of problems solving skills based on error types: high, moderate, and low. Then, the data was presented in tables, described, classified, and concluded.

3. Finding and Discussion

3.1. Effectiveness of Osborn Simple Feedback Learning Model Implementation to the Students’ Problem Solving Skill

The research was conducted within probability material with 4 meeting with period of learning 8 x 40 minutes/learning hours on May 2019. The effectiveness of the model toward the students’ mathematics problem solving skill at VIII grade could be seen from the hypothesis test. The test was processed by SPSS 20 and Microsoft Excel. Before testing, there was a need to test its normality and homogeneity. The normality from both classes was 0.115 and the homogeneity was 0.106. They were normally distributed so that the calculation used parametric statistic. Here is the test result.

The result of individual completeness assisted by SPSS showed sig score of 2 – tailed = 0.000. Since the test used one party test, then P – value ≤ \( \frac{1}{2} \alpha \) or 0 ≤ 0.025. Thus, \( H_0 \) was denied. It could be concluded that the average of mathematics problem solving skill had passed BTA. The result of classical completeness by using z test assisted by Microsoft Excel showed \( z_{count} = 2.491 \) and \( z_{table} = 0.173 \). Because \( z_{count} > z_{table} \) then \( H_0 \) was denied and it could be concluded that mathematics learning by using the model classically completed and had passed 75%. It was in line with Analiswati stating that learning by using feedback method could improve mathematics learning achievement with 30% increase of learning outcomes and the percentage of student learning achievement completeness reached 70% than previous model [17].

The analysis of average variances assisted by SPSS showed sig score of 2 – tailed = 0.047. Since it was one party, then P – value ≤ \( \frac{1}{2} \alpha \) or 0.024 ≤ 0.025, so that \( H_0 \) was denied and could be concluded that average score of the students’ mathematics problem solving skill on Osborn Simple Feedback model was higher than those taught by Discovery learning. The analysis result of the data by using z test assisted by Microsoft Excel showed that proportional test of experimental and control groups’ problem solving skill showed \( z_{count} = 2.910 \) and \( z_{table} = 1.64 \). Because \( z_{count} > z_{table} \) then \( H_0 \) was denied. Thus, it could be concluded that proportional completeness of mathematics problem solving skill taught by Osborn Simple Feedback was higher than those taught by Discovery learning. It was in line with Angriani [18] stating that mathematics learning through providing quiz with feedback could improve learning achievement of X6 students of SMA Negeri 2 Sinjai [18]. Oktavianti [19] also stated that Osborn model with Mnemonic technique through constructivism theory influenced the students’ mathematics problem solving skill. The mathematics problems loving skill of the students taught by Osborn were better than the conventional one. Artilita [20] also stated that mathematics problem solving skill of students taught by Osborn was higher than those taught by expository. The students also gave positive attitude toward Osborn learning model [20]. Based on the explanations, it could be concluded that Osborn Simple Feedback was effective to improve mathematics problem solving skill of the students.

The learning success is also determined by learning which motivates students’ creativities. Osborn simple feedback model made students thinking creatively and participated actively in learning. The learning was done within groups and there were several supportive learning media. The students seemed to be more enthusiastic in following the learning and solving the problems. The learning was in line with constructivism theory stated by Gagne. Gagne stated that learning is an action to foster, develop and modify knowledge, skill, habit, preference, and attitude. Learning causes behavioral changes which are learning outcomes. Discussion is only one of activities to involve students in developing their own knowledge by finding out concepts, investigating the objects directly, and
solving problems. Besides that, learning was also supported by feedback for both oral and written as stated in constructivism theory. It was assumed to be the empowerment whose purpose to facilitate students in developing and mastering performance in solving simple task until the more complex one. Osborn simple feedback learning model had same pattern in each activity. The given LKPD in each meeting facilitated students to master the learning material and problem solving skill stages gradually. Furthermore, in the end of each meeting, the students were given quizzes to support both aspects. The teacher provided written feedback on each student’s answer which contained comments of their results and suggestion to revise their process in working on the questions. It was done to let the students know their error and solutions. Such feedback was in line with behaviorism theory, stating that feedback functioned to empower the correct answer and to make the information corrective in helping students revising their error. Then, the correction and analysis of errors became important components in learning and feedback functioned as verification upon response certainty or answer level certainty from the students. Based on the findings and discussion, it could be known that Osborn Simple Feedback could improve mathematics problem solving skill of the students.

3.2. Analysis of the Students’ Error Types in Solving Mathematics Problem
In this research, the students’ mathematics problem solving skill were categorized into high, moderate, and poor. The categorization was done by using Azwar’s categorization [21]. Based on the category results, two students were selected randomly as research subjects for each category of skill. The subjects based on the categorization could be seen on Table 1.

| Frequency of Mathematics Problem Solving Skill | Categories | Research Subjects |
|-----------------------------------------------|------------|-------------------|
| 11                                            | High       | S-1 and S-2       |
| 9                                             | Moderate   | S-9 and S-18      |
| 6                                             | Poor       | S-15 and S-26     |

The error types of the students in solving problem for each category is shown on Table 2.

| Categories | Research Subjects | Error Types in Solving Mathematics Problems for Each Question Indicator |
|------------|-------------------|-------------------------------------------------------------------------|
|            |                   | Indicator 1 | Indicator 2 | Indicator 3 | Indicator 4 |
| High       | S-1               | -           | -           | -           | P and E     |
|            | S-2               | -           | E           | -           | -           |
|            | S-9               | E           | -           | -           | P and E     |
|            | S-18              | -           | -           | P and E     | P and E     |
| Moderate   | S-15              | R, C, T, P, and E | E       | E           | P and E     |
|            | S-26              | E           | E           | E           | R, C, T, P, and E |

Remarks: R = Reading Error, C = Comprehension Error, T = Transformation Error, P = Process Skill Error, E = Encoding Error.

Based on the table, it could be seen that on indicator 1, identifying problem which correlated to probability by presenting problems into sketch, figures, charts, or other patterns, the S-2 student had difficulties on encoding stage. S – 15 did error on all answers. S – 26 did error on encoding stage. Meanwhile, S – 1, S – 2, and S – 9 did not do any error in indicator 1. In indicator 2, developing new mathematics knowledge about probability through problem solving, S-2, S-15, and S-26 did error on encoding stage. S-1, S-9, and S-26 did not do error in indicator 2. In indicator 3, solving problems about probability by using accurate strategy, S-15 and S-26 did error on encoding stage. S-18 did error
on encoding stage and process skill stage. S-1, S-2, and S-9 did not do error in indicator 3. In indicator 4, arranging problem solving solution by different stages, S1, S-9, S-18, and S-15 did error on process skill and encoding stages. S-26 did not do error on all answers. S-2 did not do any error in this indicator. Based on the interview result, the error were generally caused by their recklessness, carelessness, and haste in finishing the question. They had not been able to work on the question by paying attention on problem solving stage or directly moving to process skill stage. Their understanding toward problems in the form of story question were still poor.

The students’ problem solving skill on each category – high, moderate, and poor – were varied. Based on Table 2, it was known that many errors done by the students in solving problems. It was encoding error. It was in line with Haryati, Suyitno, & Junaedi [22], Islamiyah, Prayitno, & Amrullah [23], and Safitri, Sugirti, & Hutama [24]. Ellerton & Clements stated that NEA framework is a hierarchy, error on each solving process level could hinder students to get appropriate solution [24]. Based on the findings and argument, it was known that the student committing error on certain stages would have several error in the next stages. It also influenced accuracy of their obtained answers.

4. Conclusion
Based on the finding and discussion of the learning implementation, it could be concluded that Osborn Simple Feedback model was effective to mathematics problem solving skill of the students. The implementation of the learning model provided opportunity for students to think creatively. The existence of feedback had enhanced and motivated them to revise their previous error. It was in line with Osborn Simple Feedback model role to improve problem solving skill based on constructivism and behaviorism theories. Based on the analysis and discussion of error types of the students in solving mathematics problem, it was known that the students’ skill in each category and subject was different. It showed that the error of the students on each question were varied and fluctuate if they were trained continuously.

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