The effectivity of corrective formative evaluation on ability to understand geometric concepts

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Abstract. The aim of this study are to know the effectiveness of the corrective formative evaluation on the ability to understand geometric concepts of the students. This research is a quasi-experimental study with samples thirty two students. The data was analyzed by using covariance analysis with students’ initial ability as covariate. The results of the study show corrective formative evaluation give effective contribution on the ability to understand geometric concepts with a contribution 44.5%. This study also indicates there is a significant effect of students' initial ability as covariate on the ability to understand geometric concepts 35.2%. The average the ability to understand geometric concepts of the students taught with corrective formative evaluations is higher than conventional classes.

1. Introduction

Misconceptions is one of the problems faced by students in learning geometry. Angel and Adela [1] said that many students do not understand the altitude concept in a triangle. They have difficulty to determine the altitude of a triangle when the position of the triangle changed. Such students perceive that the altitude of a triangle is a line which is perpendicular to the horizontal base. Some other common misconceptions are an angle must have one horizontal ray; a right angle is an angle that points to the right; to be a side of a figure a segment must be vertical [2]. Özerem [3] revealed that 7th grade secondary school students have a number of misconceptions in angles and shapes, transformations and construction, and 3-D shapes. Mistakes and misconceptions of the 8th grade students on the subject of angles in geometry were also indicated by Biber, Tuna, and Korkmaz [4]. Rosser, Lane, and Mazzeo [2] state that misconceptions are considered to be one of the greatest contributing factors to the high failure rate of learners in geometry.

Such problems above were also found in secondary school Bengkulu city. Learning achievement of the students in geometry is lower than other branches of mathematics such as algebra, set, and statistics. From interview, some mathematics teachers give information’s that this problem was caused by lack of students’ understanding of geometric concepts.

Suherman [5] states that learning concepts do not memorize, but try to understand those concepts. Studying by memorizing the formulas will not meaningful without understand the concepts. Understanding the concepts is the key for mastering mathematics. Kesan and Kaya [6] said that the reasons for misconceptions can be caused by lesson books, teachers factor and not having information of the students’ past knowledge, not preparing the appropriate environment, wrong usage of technological tools.
Teaching failure is caused by teachers’ inability to provide teaching approach which is appropriate with students’ level of thinking. The theory of geometrical thinking proposed by Van Hiele in the 1950s suggested five sequential and discrete levels of thought a learner passes through. If students are not in a particular level of Van Hiele model, they might not be able to perceive what the teacher sees in a geometric situation so higher levels of understanding is required. Misconceptions arise frequently if learners bypass or skip a level from the Van Hiele model [7].

Studying geometry is an important component of learning mathematics because it allows students to analyse and interpret the world they live in as well as equip them with tools they can apply in other areas of mathematics [3]. Therefore, students need to develop an understanding of geometric concepts.

Good teaching strategies is factor that can encourage the success of understanding mathematics concepts. Herawaty and Widada show there is an influence of contextual learning models and Cognitive Conflict on students’ understanding of mathematical concepts [8]. Another teaching strategy is through evaluating the learning process. By evaluating the learning process, the teachers obtain information about students’ achievement, students’ difficulties, and students’ mistakes. The teachers can provide improvements and revise the learning program. Evaluation that can provide feedback to the teachers the weaknesses of learning process that has been implemented is called formative evaluation. Formative evaluation can give consideration to the ongoing learning program. Tessmer [9] said that formative evaluation is a method of assessing the value of a program when program activities are occur. Formative evaluation provides consideration in the ongoing learning process. Formative evaluation is usually carried out by the teacher at the end of each lesson plan.

Evaluation is an important aspect that needs to be developed and implemented in the teaching and learning process. With evaluation we can measure the achievement of learning objectives and educational interaction. So, the evaluation has an important role for improving the teaching and learning situation. According to Purwanto [10], evaluation activities in schools have three functions, namely: (1) knowing the progress of the students, (2) knowing the achievement of a teaching model or method, (3) knowing the weaknesses of learning outcomes. Formative evaluation aims to improve the learning process. There are four types of formative evaluations namely expert review, one-to-one, small groups, and field tests [9].

Kalaha, Zakaria, and Franky [11] show the average mathematical mastery of students given formative evaluation treatment with feedback is higher (75.93) than the students without such treatments on the topics cube and box (69.35). Moyosore [12] revealed that formative assessment had a strong significant difference in the mean achievement scores of mathematics students that were exposed to it. Said and Mouzrati [13] investigated teacher written corrective feedback as a formative assessment tool and asked students’ responses. Some students’ responses about teacher’s correction feedback are tend to correct all their mistakes, locate weaknesses and negative areas only, focus on language form not development ideas. The result of the research revealed strong mismatches between teachers espoused beliefs concerning written corrective feedback, as a formative assessment tool, and their actual classroom practices.

Formative evaluation which is focused in this research is one-to-one per person. Individual evaluation is good for identifying mistakes and problems in a rough draft. This evaluation is applied using the corrective model. Formative evaluation with corrective is evaluation by correcting students’ misconceptions and writing the correct answers on the student’s answer sheet. Correcting is done not only on the wrong answers (negative correction), but also positive correction. Positive correction means giving a reward by writing “excellent or good” on the right answer to motivate the students.

The weakness of corrective formative evaluation is the information students receive about one direction from the teacher. Information received by students consists; (1) learning achievement test scores, (2) correction or explanation of the items answered incorrectly by students on the answer sheet. The benefits of corrective formative evaluation are keeping secrecy the scores obtained by students, because the corrections are directly given to students without anyone else attending. Another benefit is the students remain protected although their score is very low. Students can immediately revise their mistakes without asking for help from their fiends by re-analysing the instructions or explaining the
teacher gives on the student answer sheet or paper. It also provides additional explanation or instructions on how to solve the problem.

Formative evaluation that uses a teaching approach to provide an explanation of the mistakes made by students will help to enhance understanding of geometrical concepts so that students’ difficulties in learning geometry can be overcome. The purposes of this research are to know the effective contribution of corrective formative evaluation on the ability to understand geometric concepts, the effect of students’ initial ability on the ability to understand geometric concepts, and to know mean difference the ability to understand geometric concepts of the students taught by corrective formative evaluations and those taught conventionally.

2. Methods
This research is a quasi-experimental study which was implemented in Secondary School (SMPN 1) Bengkulu City from February until May 2019. In this study three variables were involved, namely the independent variable, the covariate variable, and dependent variable. The independent variable is the corrective formative evaluation model, the covariate variable is students’ initial ability, while the dependent variable is the ability to understand the concept of geometry. The population in this study was all 8 grade students consist of 6 classes. The sampling technique was done by simple random sampling technique from six classes selected two classes, as experiment and control class.

The research instrument is a test of the ability to understand geometric concepts. This test is developed from indicators restating concepts, classifying concepts, and presenting concepts in the form of mathematical representations. The validation of the test instrument was expert judgment and try out to the students to obtain a reliable test. The expert judgment results was analysed using Anava Hoyt in [14]. The results of expert judgment shown in Table 1.

| Source of Variation | SS   | Df | MS   | r11  |
|---------------------|------|----|------|------|
| Rows                | 75.077 |   | 6.256 | 0.867 |
| Columns             | 4.154  | 3  | 1.385 |      |
| Error               | 29.846 | 36 | 0.829 |      |

The results of calculation in Table 1 show \( r_{11} = 0.867 \), greater than 0.70. This means that the test is reliable. Test of ability to understand geometric concepts consist of 6 items was tried out to the students to know the validity, difficulty index, discrimination index, and reliability of items. The try out results show all items hold the criteria of validity, discrimination index, difficulty index, and reliability, so the number of items used 6 items. Data was analysed using covariate statistical analysis with students’ initial ability as covariates. The effect of formative corrective evaluation model on the ability to understand geometric concepts before being controlled with a covariate was analysed by using t-test.

3. Result and discussion

3.1. Result of test understanding geometric concepts
This section describe the results of formative evaluation of the students on geometric concept. The results which will be discussed only sample of students’ answer on two items. The first question measure students’ understanding about the altitude and area of triangle. The second question measure students’ understanding about rectangle. The two questions are presented in Figure 1 and Figure 2. Twenty five students cannot draw the altitude of Δ ABC. They said not possible to draw perpendicular line to the base of triangle since the base of triangle is short. This may be caused the teacher usually draw a triangle with the altitude perpendicular to horizontal base when teaching. Seven students try to draw the altitude to the side BC, but they did not make perpendicular line correctly. All students answer “DF” is the altitude of Δ DEF and write the area of the triangle correctly, that is DE times DF divided by two.
Eighteen students were not able to determine the measure of angle $\alpha$ in degree, but they answer by estimating about 35 degree. These students can not apply the concepts the sum of angles in a triangle is 180 degree. Fourteen students can answer that $\angle \alpha = 30^\circ$ by applying concept the sum of the angles in a triangle. However all the students did not realize that the figure is a rectangle. Most students said that the figure is parallelogram. It seems that the students forgot the concept of rectangle. This may be caused the figure is depicted in different position from common figure given by the teacher.

3.2. Results of requirements analysis

The results of normality test using Kolmogorov Smirnov are shown in the following Table 2. Calculation results show the four data groups namely KAE (initial ability of experimental class), KAC (initial ability of control class), PKE (ability to understand concepts of experiment class), and PKC (ability to understand concepts of control class) are normally distributed with each significant values greater than 5%.

| Data | $N$ | KSZ | Sig  | $\alpha$ | Explanation |
|------|-----|-----|------|----------|-------------|
| KAE  | 32  | 0.607 | 0.854 | 0.05     | Normal      |
| KAC  | 32  | 0.699 | 0.713 | 0.05     | Normal      |
| PKE  | 32  | 0.621 | 0.836 | 0.05     | Normal      |
| PKC  | 32  | 0.649 | 0.794 | 0.05     | Normal      |

Homogeneity test was done using Fisher test. The pairs of data that are tested are (1) the initial ability and the ability to understand geometric concepts of the experimental class namely KAE and PKE. Based on calculation, obtained the value of $F=1.231$ less than the value of table $F=1.822$. This means that data is homogeneous, (2) the initial ability and the ability to understand geometric concept of class control, namely KAC and PKC are also homogeneous with calculated $F=1.173$ less than the value of table.
F=1.822. The data pair that are tested for linearity is the initial ability of two classes and the ability to understand geometric concept. Deviation line from Linearity shows a sig value of 0.803 is greater than 0.05, which means linear data. From the results of analysis requirements test can be concluded that all the data obtained from population with normally distributed and have homogeneous variance and have a linear relationship between the independent variable and the dependent variable.

3.3. Results of data analysis
The description of the initial ability data and the ability to understand geometric concept are presented in Table 3. The results of calculations show the mean of PKE>PKC and the mean of KAE>KAC. This means there is interaction between initial ability and the ability to understand geometric concept.

The results of calculations using covariance analysis are presented in Table 4. On the class line for corrective formative evaluation is obtained the value of F=48.902 with a sig value of 0.000 <0.05. So, there is an effective contribution (very significant) corrective evaluation model on the ability to understand geometric concept with the amount of contribution 44.5%. In the covariate line (X), it is shown the value of F= 33.101 with a sig value of 0.000 <0.05. This means the initial ability (covariate) has a significant effect to the ability to understand geometrical concept. The amount of the effect is 35.2%.

3.4. Discussion
The results of analysis show that the effective contribution of formative corrective evaluation model to ability to understand geometry concepts is 44.5%. This shows that the corrective formative evaluation model can provide input to the teachers about the weaknesses and strength of the learning process that has been implemented so that enhance understanding increases understanding geometry concepts. Another result shows that there was a significant effect of the initial ability covariate on the ability to understand concept about 35.2%. This means that the initial ability gives a strong effect on the ability to understand geometric concept. The results also show there is a significant differences in the average of ability to understand geometric concept between class taught by corrective formative evaluation models with conventional class. The amount of increasing the ability to understand the geometry concept of the experimental class with the control class was 19.15% higher than the amount of increasing the ability to understand the geometry concept between the experimental class and the control class before using the initial ability covariate, that is 18.28%.
4. Conclusion

From this research can be concluded that corrective formative evaluation give effective contribution on the ability to understand geometric concepts with the value of contribution 44.5%. The initial ability of the students give effect on the ability to understand geometric concept 35.2%. The average ability to understand geometric concept of students taught with formative evaluation model is higher than students in conventional class.

It is suggested to the teachers to use corrective evaluation model in teaching. For further research it is suggested to apply other formative evaluation models in order to find the most effective one.

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