Statistical reasoning of prospective teachers through blended learning

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Abstract. Blended learning is a learning model that combines face-to-face learning in classroom with online learning. This research is a descriptive study that aims to describe the ability of statistical reasoning of prospective teachers through the Blended Learning models. The subjects in this study were 40 students of second year of Mathematics Education Department at Universitas PGRI Palembang in Academic Year 2018/2019. Data collected through written tests and interviews. The test aims to reveal the statistical reasoning of prospective teacher students. The interview aims to explore further about students' statistical reasoning through Blended learning. The results showed that the statistical reasoning of prospective teachers after applying Blended Learning was included in the good category.

1. Introduction

Statistics is a compulsory subject for students of Mathematics Education. Learning statistics in higher education aims to develop students' statistical reasoning abilities. This ability is needed by students to master the concepts in statistics that can be applied both in research and in real life.

Statistical reasoning is defined as how a person uses his mind to reason and understand information in statistics [1]. Statistical reasoning involves many statistical concepts such as combining data concepts and probability. Statistical reasoning as forming conclusions and decision making based on data obtained from observations, experiments and surveys [2].

Based on preliminary studies, students' statistical reasoning abilities need to be improved. This is seen from the results of the students' Final Semester Examinations in the Statistics Method course in the Mathematics Education Department at Universitas PGRI Palembang in 2018. Students who have high statistical reasoning abilities of 8%, 60% of students with moderate abilities and 32% of students have the ability low statistical reasoning.

Considering the importance of the statistical reasoning for students, it is necessary to accommodate the students with an innovative learning. One’s of the alternative way to develop the thinking ability of prospective teacher students is applying the blended learning model. This model is a learning model that combines face-to-face learning in class (traditional) and online learning [3]. In this model, the instructor carries out teaching and learning activities in a number of initial meetings in the classroom, then learning and interaction between the instructor and learner is carried out on line.

Application of the blended learning model ideally can improve student learning outcomes. This learning model is more effective than traditional learning models [4, 5]. The success of the blended learning model today is not just text, but is proven to be able to improve mathematics learning achievement, improve understanding of concepts and mathematical literacy abilities [3, 6 - 9].
Therefore, blended learning model is expected to improve students' statistical reasoning abilities. This study aims to describe the statistical reasoning of second year students of Mathematics Education Universitas PGRI Palembang academic year 2019, through the application of blended learning. The teaching instruction in this blended learning model refers to the stages of the learning model developed by Alessi and Trollip [10, 11] as follows: (1) presenting information, (2) guiding the learner, (3) practicing and assessing learning. The aspect of statistical reasoning in this study was based on Jones, et al [12] framework, as follows: (1) describing data, (2) organizing and reducing data, (3) representing data, and (4) analyzing and interpreting data.

2. Method

The subjects were 40 students of second year of Mathematics Education Department at Universitas PGRI Palembang in 2018/2019. Blended learning in this study used in two modes: classroom and online learning. Four learning activities based on Alessi and Trollip were driven in this study. Classroom learning takes 3x50 minutes for a week. In face-to-face learning, expository learning was conducted. Online learning was conducted after classroom meeting. Learning activities in online consisted of online learning resources, group discussion, test formatives, and final examination. This study adopted one shot case study design. Data were collected through tests and interview, at the end of experimental semester. Test was conducted to explore the statistical reasoning. Interviews are used to find out more about students' statistical reasoning. Data were analyzed descriptively.

3. Result and Discussion

3.1. Blended Learning Process

This study used Blended Learning in teaching and learning activities in Statistics course. The traditional or classroom learning used expository method. Face-to-face activities in classroom meeting are design based on Statistics’ Course Lesson Plan. Online learning was available at: https://e-learning.univpgri-palembang.ac.id. The phase’s instructions in this study were described as follows: (1) Presenting information

Teacher gave the information about the topic in classroom. It is also presenting in online course in form of files and videos (Figure 1). Students were encouraged to use these material resources.

![Figure 1. Online resources](image)

Presentation of material in online learning can help students understand it. Students have more time to learn and can repeat it to answer the practice questions. Therefore, with the additional time to learn in Blended Learning, this can improve learning achievement [9].

(2) Guiding the learner

Teacher used group discussion both in face-to-face and online learning. Some problems which are related to statistical reasoning were posted on group discussion (Figure 2). The problem was asked students to: describing data, representing data, organizing and reducing data, analyzing and
interpreting data. This phase of instruction is useful for students to improve their performance in statistical reasoning. The communication between teacher and students, in classroom and online learning became more effective. Teacher also helped students to find out the solution. During the process of group discussion, teacher gave more explanation if students had a problem.

![Figure 2. The example of online group discussion](image)

When teacher posting a problem, and students find out the solution is one way to create effective mathematics learning [13]. Students can express their opinions or obstacles encountered in solving problems in this group discussion. This also succeeded in making students active in learning [8], and could increase interactions between teachers and students [5].

(3) Practicing and assessing learner

Teacher gave opportunity to students to practice in the classroom and online learning. Online test formatives and final assignment were available for students to study at home. Students were expected to take these tests, so that they can get the feedback and knowing their performance (Figure 3).

In this research, formative tests can be done by students in a number of repetitions. Thus students have time to explore and improve their abilities. Teachers can see how far students mastering the topic. Based on the result of test formatives, teachers also could provide feedback to students who make mistakes. This was identified could improving students' understanding [5,6,9].

![Figure 3. Students participation in test formative](image)
3.2. Students’ Statistical Reasoning

Statistical reasoning of secondary year students of Mathematics Education Department Universitas PGRI Palembang in academic year 2018/2019 can be seen in Table 1.

Table 1. The distribution of students’ statistical reasoning

| Test Score | Frequency | Category  | Percentage |
|------------|-----------|-----------|------------|
| 80 – 100   | 18        | Very good | 45%        |
| 66 – 79    | 5         | Good      | 12.5%      |
| 56 – 66    | 6         | Fair      | 15%        |
| 46 – 55    | 5         | Less      | 12.5%      |
| 0 – 45     | 6         | Poor      | 15%        |
| **Total**  | **40**    |           |            |

The average value of students' statistical reasoning abilities is 71.09, included in good category. The highest score is 100 and the lowest score is 25. The students’ achievement for each aspect of statistical reasoning ability can be seen in Table 2.

Table 2. Student achievement of statistical reasoning

| Statistical reasoning aspects                  | Percentage | Category |
|------------------------------------------------|------------|----------|
| Describing data                               | 77.50%     | Good     |
| Organizing and reducing data                  | 76.88%     | Good     |
| Representing data                             | 66.88%     | Good     |
| Analyzing and interpreting data               | 63.13%     | Fair     |

The description of students' statistical reasoning for each indicator is as follows:

1. Describing data; students can understand the meaning of a normal distribution curve. In this indicator students are asked to determine the probability of area using normal distribution curve. Based on Table 2, it is found that 77.50% students have the right answer. After conducted the interviews with some students, it is known that more practicing in blended learning model help students in describing data.

2. Organizing and summary of data; students can summarize real-life problems related to binomial distribution in statistical symbols, so that the problem can be solved. This problem was being discussed. Based on the interviews, it is found that students were remembering the steps for organizing and making summary for the problems. Students took a benefit form blended learning model. They have more time to practice with this model. Practicing the statistical reasoning problem in blended learning model made students easier to organizing and summering data. They used what they have learn, to solve the problems.

3. Representing data; students can present real life problems to normal distribution curve. This indicator was more difficult than two indicators stated before. Based on interviews, it is known that students were confused in finding the meaning of statistical problems.

4. Analyzing and interpreting data; students can analyze and interpret problems into normal distribution and determine the solution. It means that students can make predictions or conclusions for normal distribution problems. To achieve this aspect, students must go through 3 previous aspects. Students who felt difficult in aspects 1, 2 and 3 cannot achieve the fourth aspects. Student achievement for data analysis and interpretation indicators is 63.13%. After conducted the interviews, it is known that students had a trouble in understanding the normal distribution. This statement is in a line with Moore [14], students felt difficulties in making inference.

Blended learning models applied in this study can improve students' statistical reasoning abilities. Students show their participation and enthusiasm in learning this model. Example of student comments on the application of this model can be seen in Figure 4.
4. Conclusion
Based on the results of the study, the statistical reasoning ability of prospective teacher of second year Mathematics Education Department at Universitas PGRI Palembang academic year 2018/2019 was in good category. The highest statistical reasoning aspect appearance was describing data, which is equal to 77.50% and the lowest aspect was analyzing and interpreting data 63.13%. Further study can use this model to improve other statistical or mathematical abilities. Although this model can be used as an alternative to learning, in its implementation there are still some obstacles that must be faced such as internet networks that are not always available to students and students' difficulties in understanding the normal distribution.

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