

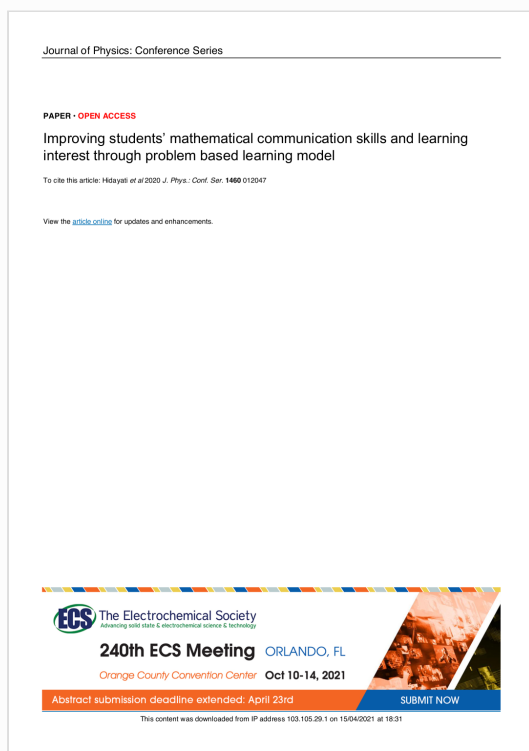


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PAPER • OPEN ACCESS**Improving students' mathematical communication skills and learning interest through problem based learning model**

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Improving students' mathematical communication skills and learning interest through problem based learning model

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Abstract. One of the objectives of mathematics learning is to improve mathematical communication skills. One learning model that can improve such skills is problem based learning (PBL). This study aimed to examine the improvement of students' mathematical communication skills and students' motivation in statistics using PBL. The method used in this study was classroom action research (CAR). Twenty-seven Year 12 students participated in the study. The instruments used included a test for examining students' mathematical communication skills, observation sheet for observing student activities, and observation sheet for evaluating the ability of teachers in managing the learning. The results showed that there was an increase in students' mathematical communication skills through PBL model in Cycle I and II, the average score was 68.89 and 75.56, respectively. The students' interest in learning mathematics through PBL, specifically statistics, was also improved in each Cycle, with an average of 51% and 67% for the Cycle I and II. The finding of this study can be used as a reference to improve students' mathematical communication skills using the PBL model. The PBL model also has a positive impact on students' interest to learn mathematics and it can contribute to help students achieving the mastery learning of statistics.

1. Introduction

Mathematics plays an important role in education and can develop critical, creative, systematic, and logical thinking. Mathematics has also contributed to everyday life from basic calculations to complex and abstract concepts. One of the purposes of mathematics learning is to improve mathematical communication skills [1].

The Indonesian students' mathematics performance in the international assessment has not shown satisfactory results. It can be seen from the International studies: Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA). The results of TIMSS from 1999 to 2015 indicate that Indonesia was ranked 34th-45th out of 38-50 countries. TIMSS 2011 placed Indonesia at the 38th out of 42 countries, with a score of 386 [2], while it was at the 45th out of 50 countries, with a score of 397, in TIMSS 2015. Similarly, the results of PISA 2015 also reflected on the poor performance of Indonesian students' mathematics literacy, ranked as the 64th out of 65 participating countries (the score of 375) [3]. OECD [4] also reported unsatisfactory results



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of Indonesian students in PISA 2015, where Indonesia was ranked the 63rd out of 70 countries (the score of 386).

Mathematical communication skill is one of the abilities students require. However, students' communication skills are still low while the teacher has applied an active learning model following the demands of the 2013 curriculum. One of the contributing factors affecting the low communication skills of students is the low initial ability of students to identify problems [5].

Mathematical communication is important for students. Baroody [6] defined the importance of communication as follows: 1) mathematics as a tool to communicate ideas clearly, precisely and accurately; and 2) mathematics as a social activity in learning mathematics. Thus, teachers need to know the communicative classroom environment. Communicative classroom environment occurs when the students: 1) express mathematical ideas orally, in writing, demonstration, and visualising them in different types, 2) understand, interpret, and assess ideas presented in writing, orally, or visual form, and 3) construct, interpret and connect various representations of ideas and their relationships [7]. Sullivan and Muosley [8] emphasised that mathematical communication is not only expressing ideas through writing but also, more broadly, the ability of students concerning speaking, explaining, describing, listening, asking, clarifying, cooperating (sharing), writing, and finally reporting.

Based on the preliminary observation and the discussion between the researchers and Year 12 mathematics teachers, it showed that mathematical communication skills and students' learning interest were poor. The students often had difficulty in expressing, interpreting, and evaluating mathematical ideas both verbally and in writing; as well as in demonstrating and visualising them visually. They were also not accustomed to using the mathematical terms or notations, using structures for presenting ideas, and describing relationships between the situation models. The results of the test of statistic topic in the first-semester exam in 2016/2017 academic year showed that only 13 out of 29 students met the criteria of mastery learning (44.83%). After reviewing the test results, the researchers found that the students did not understand the purpose of the questions in statistics. In addition, based on the exercises given by the teacher, only a few students could express their ideas in writing, use mathematical terms or notation. Besides, the teacher said that students' interest in doing the exercises was also lacking.

The lack of Year 12 students' mathematical communication skills and learning interest were due to the learning model applied. It was not successful in improving the mathematical communication skills and learning motivation of the students. The learning process was teacher-centred and did not reflect an active learning atmosphere. To overcome these problems, innovative learning models that can provide learning experience for students in developing students' mathematical communication skills is necessary. In improving mathematical communication skills, students need to be supported by the right approach or learning model so that the learning purposes can be achieved.

One learning model that can improve students' mathematical communication skills is problem-based learning (PBL) model. PBL is a learning strategy that encourages students to be active and confident in learning [9]. Four stages of PBL include: 1) orienting the students about the problems, 2) organising students to research, 3) assisting independent and group investigations, 4) developing and presenting artefacts or exhibits, and 5) analysing and evaluating the problem solving process [10].

Based on the above description, it can be said that students' mathematical communication skills are crucial to developing so that the students can communicate well, both between students and between students and teachers. With excellent communication skills, the students can solve their mathematical problems better, especially the problems in their daily life. The students can also deliver information obtained from group working better, so the information presented can be understood by others.

Learning interest also influences student achievement. A learning model where students can teach each other, share knowledge and discuss, can improve student learning outcomes [11]. Sucipto argued that students' motivation in learning could be influenced by an educational approach that focuses on creative thinking, problem solving, and interaction between students [12]. According to Hardjana, the learning interest is the tendency of the heart to learn to obtain information, knowledge, skills through effort, teaching or experience [13].

Thus a great interest can influence learning activities. Students who are interested in mathematics will learn mathematics seriously and diligently. They will also feel happy engaging in mathematics lessons and can even solve the exercises and other assignments. Students will easily memorise the lesson and the learning process will run smoothly. Therefore, teachers need to foster students' interest, and then they can easily understand the lessons. Judging from the factors affecting students' motivation in learning, Slameto argued that the decrease in student interest is due to two factors, internal and external factors, and one external factor is the constructive learning model [14]. Based on these problems, the purposes of this study were to improve students' mathematical communication skills in statistics through the PBL model and to examine the increase in students' interest in learning mathematics through PBL model.

2. Methods

The method in this study was classroom action research (CAR), consisting of four stages: planning, acting, observing and reflecting. The study was conducted at Aceh Besar Regency, Aceh, Indonesia. The research subjects were 27 Year 12 students (7 male and 20 students). The study was conducted in the second semester on statistics through PBL model in two learning cycles and four lessons.

The instrument used were tests, student activity observation sheet, teacher ability observation sheet, and student learning interest questionnaire. The tests of mathematical communication skills (pre-test and post-test) consisted of short answer problems. The student activity observation sheet was used to examine student activities, while teacher ability observation sheet was to investigate teacher's ability in managing the learning. Besides, student learning interest questionnaire was to discover the level of students' interest in learning mathematics. Student mastery learning was analysed following the criteria of mastery learning, that were 75% and 85% for individual and classical mastery learning respectively. Student activities and teacher's ability in managing learning were analysed based on the scoring criteria of excellent, good, average, fair and poor. The response to students' mathematics learning interest questionnaire was analysed by the criteria of excellent, good, average, fair and poor.

3. Results and discussion

The results of students' initial test described that the students' abilities on statistics were unsatisfactory, 20 out of 27 students (74%) did not meet the classical criteria of mastery learning. The initial test result data became a reference for the learning process in Cycle I.

Student learning outcomes in Cycle I illustrated the ability of students to solve statistical problems taught by using PBL model, with an average score of 68.89. 18 out of 27 students satisfied the criteria of individual mastery learning. This is because students did not understand the prerequisite material about mean, median and mode, it can be concluded that the learning of Cycle I had not met the criteria of classical mastery learning.

Student learning outcomes in Cycle II showed that the average ability of students in solving statistical problems was 75.56, 24 students (89%) met the criteria of individual mastery learning. This means that students also fulfilled the criteria of classical mastery learning (greater than 85%).

Cycle II showed an improvement in student achievement as seen in the post-test results; it means that the PBL model can improve student learning achievement. It is in line the finding of Rahayu et al. and Pratiwi et al. reported that PBL learning models can improve student learning outcomes [15,16]. Karatas and Baki, in their research, also argued that the experimental class using PBL learning model could better improve student learning outcomes compared to the control class [17].

The results of the students' initial test showed that students had not met the criteria of classical mastery learning, indicating the low ability of student communication on statistics. Students' mathematical communication skills in statistics through PBL model in Cycle I noted that nine students (33%) had excellent, 11 students (41%) had good, five students (19%) had average and two students (7%) had poor mathematical ability. In Cycle II, there were 11 students (41%) with excellent mathematical ability, 15 students (56% students) with good ability and one student (4% students) with average ability.

Overall, the results of students' mathematical communication skills in statistics through the PBL model in Cycle I and II were improved. Students' communication skills could be improved by the implementation of PBL model [18-20].

Student activities in the learning process through the PBL model showed that at the first lesson of Cycle I, out of 6 subjects observed, one subject had excellent activities, two subjects had good activities and three subjects had average activities (see Figure 1).

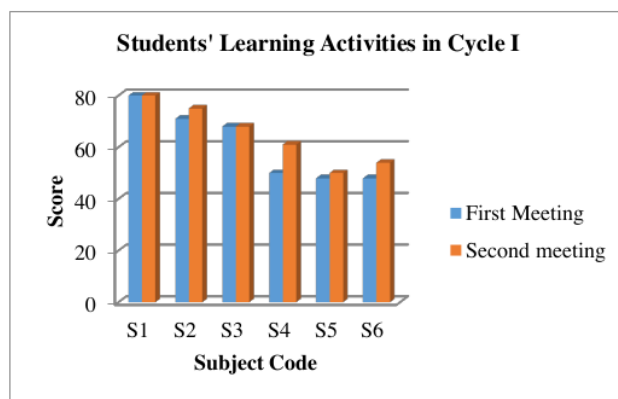


Figure 1. Student learning activities in Cycle I.

The students seem to be not engaged in learning, and they still had difficulty interacting with friends and teachers. It is because the previous learning process was dominated by the teacher delivering information. However, in Cycle II, students' activities in the learning process experienced positive changes. They could tell their perception in learning, discuss in their group, present and reflect on learning. Out of the six subjects observed, there was one subject with excellent activities and five subjects with good activities (Figure 2).

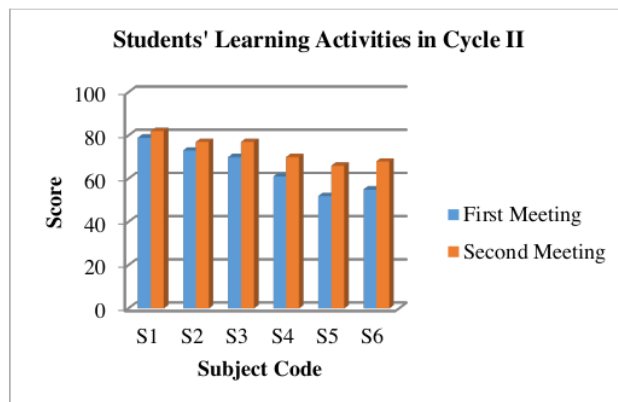


Figure 2. Student learning activities in Cycle II

Some weaknesses were seen from the observation. Students were not active during the question and answer interaction session between the teacher and students when the teacher delivered learning apperception. They were silent and talked to other students. They also were not engaged in asking and

answering questions discussed by their classmates and teachers during the learning process. They also had difficulty in expressing their learning difficulties (reflection of learning).

The teacher's activities in managing the learning at the first and second lesson of the Cycle I showed that the teacher's activities were excellent in checking the room readiness, tools, teaching instruments. The teacher was also excellent in mastering of the learning material, guiding students, and organising the activities.

In Cycle I, the teacher's activities in managing learning was also improved in term of the activities of presenting apperception based on teaching material and explaining the steps of learning about statistics. Overall, the average teacher activities in managing the learning were 80% and 83% for the first and second lesson, indicating that the teacher's activities in Cycle I was classified in the good category. In Cycle II, the teacher's activities in managing learning were also improved, the average was 86% and 89% for the first and second lesson respectively.

The students' interest in learning statistics through PBL models has also increased in each Cycle. In Cycle I, the average learning interest was 51%, showing that the students' interest in mathematics learning in statistics were average. In Cycle II, the average of learning interest was 67%, indicating that the interest was good. The results showed an improvement in students' responses to the ongoing learning cycle, with an improvement of 16%. The improvement illustrated that the use of the PBL model could foster students' interest in learning statistics.

4. Conclusion

The students' mathematical communication skills through PBL model in Cycle I and II were improved. The average score of Cycle I was 68.89 and 18 out of 27 students (67%) met the criteria of individual mastery learning. Besides, the average score of Cycle II was 75.56 and 24 students (89%) satisfied the criteria of individual mastery learning.

Students' learning interest in mathematics through the PBL model has also increased in each Cycle. The average response of students' interest in learning mathematics was 51% and 67% in Cycle I and II, respectively. It showed an increase in student responses and indicated that the PBL model could foster student motivation in learning mathematics, especially statistics.

The finding of this study can be used as a reference to improve students' mathematical communication skills using the PBL model. The PBL model also has a positive impact on students' interest to learn mathematics and it can contribute to help students achieving the mastery learning of statistics.

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