The influence of student facilitator and explaining (SFAE) learning model viewed from social skills in improving students’ mathematical representation ability

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Abstract. This study aimed to determine the influence of the Student Facilitator and Explaining (SFAE) learning model in terms of social skills in improving students’ mathematical representation abilities. This research employed the quasi-experiment design with an essay test and questionnaire as the research instruments. Both classes were given pretests and posttests. The data were analyzed using the two-way ANOVA with a significance level of 5%. The research results discovered that (1) there was an influence of the SFAE learning model in improving students’ mathematical representation ability, (2) there was an influence of high, medium, and low social skills in improving mathematical representation ability, and (3) there was no interaction between the SFAE learning model and social skills in increasing students’ mathematical representation ability. This shows that SFAE learning has an effect on increasing the representative ability of students, so it is hoped that educational institutions can use this learning in the learning process.

Keywords: social skills, students’ mathematical representation ability, student facilitator and explaining learning model

1. Introduction
Mathematics learning aims to improve various mathematical abilities [1,2]. Not only improving learning outcomes, but mathematics is also an educational program that can develop critical, logical, creative, and systematic thinking [3,4]. One of the mathematical abilities that students need to ace is the potential of mathematical representation, NCTM argues that the ability of mathematics representation is the center of mathematical studies [5].

Mathematical manifestation is the ability to communicate mathematical notion that students have learned in a certain way [6]. It is often used in communicating mathematical notion in the form of pictures or presentations of concrete objects, tables, mathematical statements, written text, or a combination of those forms [7]. Villegas argues that the importance of representation is to promote students’ fluency so that they can build concepts and think mathematically [8].

The mathematical representation ability can support students in understanding mathematical concepts, communicating their mathematical ideas [9,10], knowing the relationship between mathematical concepts and applying mathematics into realistic mathematical problems [11]. The result of research in Trends in International Mathematics and Science Study (TIMSS) in 2007 stated that
students’ mathematical representation ability was unsatisfactory where the SMP students in Indonesia ranked 36 out of 49 participating countries. This was caused by the inability of the students to solve problems related to mathematical abilities. Thus, it is necessary to enhance these mathematical proficiency [12].

The results of observations at SMP showed that the students’ mathematics understanding outcomes of at these schools are quiet low. This was expressed by Mrs. Eni Wulandari as the mathematics subject teacher where the average mathematical representation ability was only 6 because the conventional learning processes did not allow students to expand mathematical representation skill optimally [13]. Students tended to imitate the steps taught by the teacher and they were not allowed to present their representations in mathematics learning [14]. The learning procedure that can help students to be competitive in choosing the right learning model because the learning model is one of the important elements in learning mathematics [15]. One of the learning models that can be used in mathematics learning is the Student Facilitator and Explaining (SFAE) cooperative learning model [16,17].

Student Facilitator and Explaining learning model is a learning model where students active in conveying their statements or notions and interact with each other to discuss material that has not been understood [18]. The SFAE learning model can stimulate the skill of thinking optimally [19], train students to be active and innovative in handling every situation, process of tolerance, listen and respect to the statement of others, and train students to exchange opinions objectively [20].

One of the factors that affect the development of students’ mathematical abilities is the representation ability, namely students’ social skills [21]. Social skills are the ability to interact with others in a social context in a way that is acceptable to society [22]. Social skills in education are related to the students’ relationships with their surroundings [23]. The social skills in the mathematics learning process cover the students’ activeness in communicating, socializing, and discussing mathematics learning [24].

Several previous studies stated that the SFAE learning model had a good effect on learning outcomes [25–27], problem-solving ability [28,29], and concept understanding [30]. Based on previous research, the novelty in this study lies in the influence of the SFAE learning model in improving students’ mathematical representation ability and social skills.

2. Methods
The method employed in this research was the quantitative method. The design of this research was a quasi-experiment design with the 2x3 factorial design, it is shown in Table 1.

| Social Skills ($B_j$) | High ($A_1$) | Medium ($A_2$) | Low ($A_3$) |
|----------------------|-------------|---------------|-------------|
| Learning Model ($A_i$) | ($A_1B_1$) | ($A_1B_2$) | ($A_1B_3$) |
| SFAE Learning Model ($A_1$) | ($A_2B_1$) | ($A_2B_2$) | ($A_2B_3$) |
| Conventional Learning Model ($A_2$) | | | |

Population of this study was all seventh-grade students of SMP Negeri 1 Natar in the 2019/2020 academic year. Sample that had been determined through cluster random sampling was divided into two groups, namely the students of class VII C which consisted of 30 students as the practical class, and the students of class VII B which consisted of 30 students as the control class. The SFAE learning model was applied in the practical class while the conventional learning model was applied in the control class. The subject matter in this research was social arithmetic.

Before the research was carried out, the test instruments had been tested using the validity test, reliability test, discrimination index, and difficulty level test while the questionnaire was only tested for
their validity and reliability. Both of these instruments were used in this research to find out the improvement of students’ mathematical representation skill and their social skill categories.

The statistical analysis performed in this study was the t-test, two-way ANOVA, and Scheffe test with the significance level of 0.05. The t-test was performed to determine the balance between the practical class and the control class. The two-way ANOVA test was used to answer the research objectives by fulfilling two conditions, namely the sample should come from a normally distributed population and homogeneous. The Lilliefors formula was used to check the normality while Bartlett formula was used to check the homogeneity.

3. Results and Discussion

The prerequisite test was performed on the preliminary data obtained from the pre-test. Based on the prerequisite tests it was found that the sample had been taken from a normally distributed population and had the same variance. The balance test was performed on the data of the pre-test between the practical class and the control class to determine whether the population between these classes had the same mathematical abilities. The result showed that the practical class and the control class came from a balanced population.

The N-Gain value was obtained after the pre-test and post-test had been obtained. The N-Gain value was used to determine the increase in students’ mathematical representation ability. Table 2 is shown the description of the increase in mathematical representation skill:

| Classes     | $X_{max}$ | $X_{min}$ | Central Tendency | Group Variance |
|-------------|-----------|-----------|------------------|----------------|
|             | $X$       | $M_e$     | $M_o$            | R              | S              |
| Experimental| 1.00      | 0.23      | 0.57             | 0.55           | 0.79           | 0.77           | 0.23           |
| Control     | 0.76      | 0.03      | 0.34             | 0.32           | 0.20           | 0.73           | 0.19           |

Table 2 shows the increase of mathematical representation skill in the practical class with the highest value ($X_{max}$) = 1.00, the lowest value ($X_{min}$) = 0.23, mean ($X$) = 0.57, median ($M_e$) = 0.55, mode ($M_o$) = 0.79, range (R) = 0.77, and standard deviation (S) = 0.23. Meanwhile, the results of the control class had been obtained which consisted of the highest value ($X_{max}$) = 0.76, the lowest value ($X_{min}$) = 0.03, mean ($X$) = 0.34, median ($M_e$) = 0.32, mode ($M_o$) = 0.20, range (R) = 0.73, and standard deviation(S) = 0.19. So, by looking at the average N-Gain value, it can be concluded that the practical class had a higher mathematical representation ability compared to the control class. Furthermore, Table 3 displays the questionnaire result are shown in Table 3.

| Classes     | $X$       | $S$       | Social Skill Categories |
|-------------|-----------|-----------|-------------------------|
|             | High      | Medium    | Low                     |
| Experimental| 68.40     | 9.57      | 7                       | 17                      | 6                       |
| Control     | 67.43     | 8.45      | 4                       | 21                      | 5                       |

Based on the data, the practical class obtained the mean value of 68.40 and the standard deviation of 9.57. Seven students were included in the high category because their scores were $\geq 77.97$. Seventeen students were included in the medium category because their scores were $58.83 < 77.97$. Lastly, six students belonged to the low category because their scores were $\leq 58.83$. Meanwhile, the control class obtained an average value of 67.43 and a standard deviation of 8.45. In the control class, four students belonged to the high category because their scores were $\geq 75.88$, twenty-one students were included in the medium category because their scores were $< 75.88$, and four students were included in the low
category because their scores were \( \leq 58.99 \). The percentages for each category of social skills in the practical class and control class are shown in Figure 1.

![Figure 1. The Percentages of the Result of Questionnaire](image)

After the N-Gain data had been obtained, the prerequisite tests were carried out to confirm the use of the two-way ANOVA. The results of the prerequisite tests indicated that the sample had been taken from a normally distributed population and had the same variance. After the prerequisite tests had been fulfilled, the two-way ANOVA test was carried out. Table 4 is a description of the results of the Two-way ANOVA test:

| Sources                  | JK      | df | RK  | \( F_{\text{observed}} \) | \( F_{\text{critical}} \) | Description       |
|--------------------------|---------|----|-----|--------------------------|--------------------------|-------------------|
| Learning Model (A)       | 0.411   | 1  | 0.411 | 19.493                  | 4.020                    | \( H_0A \) is Rejected |
| Social Skills (B)        | 1.624   | 2  | 0.812 | 38.562                  | 3.168                    | \( H_0B \) is Rejected |
| Interaction (AB)         | 0.003   | 2  | 0.002 | 0.073                   | 3.168                    | \( H_{0AB} \) is Accepted |
| Error                    | 1.137   | 54 | 0.021 |                         |                          |                   |
| Total                    | 3.175   | 59 |      |                          |                          |                   |

The two-way ANOVA shows that \( F_{A_{\text{observed}}} = 19.493 \) with a significance level of 5% obtained \( F_{(0.05; 1; 54)} = 4.020 \) so that \( F_{A_{\text{observed}}} > F_{(0.05; 1; 54)} \) which means that \( H_0A \) is rejected. It can be concluded that there was an influence of the SFEA learning model toward mathematical representation skills. \( F_{B_{\text{observed}}} = 38.562 \) with a significance level of 5% obtained \( F_{(0.05; 2; 54)} = 3.168 \). It can be seen that \( F_{B_{\text{observed}}} > F_{(0.05; 2; 54)} \) which means that \( H_0B \) was rejected. It can be concluded that the high, medium and low social skills influenced the improvement of mathematical representation ability. \( F_{AB_{\text{observed}}} = 0.073 \) with a significance level of 5% obtained \( F_{(0.05; 2; 54)} = 3.168 \). It can be seen that \( F_{AB_{\text{observed}}} < F_{(0.05; 2; 54)} \) which means that \( H_{0AB} \) was accepted and it can be concluded that there was no interaction between learning models and social skills toward the improvement of students’ mathematical representation ability. Table 5 is shown the marginal mean data:
Table 5. Marginal Mean

| Learning Models | Social Skills | Marginal Mean |
|----------------|--------------|---------------|
|                | High | Medium | Low  |
| SFAE           | 0.86 | 0.59  | 0.43 |
| Conventional   | 0.68 | 0.40  | 0.20 |
| Marginal Mean  | 0.77 | 0.40  | 0.31 |

Based on the data, the first hypothesis ($H_{0A}$) was rejected. To see which learning model provided a better result in improving mathematical representation ability, it was necessary to see the marginal mean of the two classes. Based on Table 3, it was found that the marginal mean value in the SFAE learning model class was 0.59 while the marginal mean of the conventional learning model class was 0.40. Based on these results, it can be seen that the mean value of the SFAE learning model class was better than the conventional learning model class.

Furthermore, in the second hypothesis, a follow-up test was performed after the two-way ANOVA test had been carried out to see which social skill categories (high, medium, and low) had the best results in improving mathematical representation ability. The follow-up test used was the Scheffe’ test. The results can be seen in Table 6.

Table 6. The Result of Scheffe Test

| No. | Interactions | $F_{\text{observed}}$ | $F_{\text{critical}}$ | Description     |
|-----|--------------|------------------------|-----------------------|-----------------|
| 1   | $\mu_1 \ vs \ \mu_2$ | 54.751                 | 6.336                 | $H_0$ was rejected |
| 2   | $\mu_1 \ vs \ \mu_3$ | 54.463                 | 6.336                 | $H_0$ was rejected |
| 3   | $\mu_2 \ vs \ \mu_3$ | 3,210                  | 6.336                 | $H_0$ was accepted |

The results of this study are relevant to previous research, namely the mathematics accomplishment of students with high social skills is decent than students with moderate social skills and students with low social skills [31]. The first null hypothesis indicated that there was a difference in the improvement of mathematical representation ability between students who had high social skills and students who have moderate social skills. Based on Table 3, the average value of high social skills was 0.77 which means that the N-Gain interpretation was high. Meanwhile, students with moderate social skills obtained a marginal mean of 0.40 which means that the interpretation of N-Gain was moderate. From these results, it can be concluded that students who possessed high social skills had a better mathematical representation skill compared to the students who had moderate social skills.

The second null hypothesis indicated that there was a discrepancy in the improvement of mathematical representation skill between students who had high social skills and students who had low social skills. Based on Table 3, the mean rank of the high social skills was 0.77 which means that the N-Gain interpretation was high. Meanwhile, students with low social skills obtained a marginal mean of 0.31 which means that the interpretation of N-Gain was moderate. From these results, it can be assumed that students who possessed high social skills had a better mathematical representation skill compared to the students who had low social skills.

The third null hypothesis indicated that there was no difference in the improvement of mathematical representation ability between students who had moderate social skills and students who had low social skills. Based on Table 3, the mean value of social skills was 0.40 which means that the N-Gain interpretation was moderate. Meanwhile, students with low social skills obtained a marginal mean of 0.31 which means that the interpretation of N-Gain was moderate. From these results, it can be assumed that there was no significant difference between students with moderate social skills and students with low social skills.
4. Conclusions

Based on the results of this study, it can be concluded that Student Facilitator and Explaining learning model influenced students’ mathematical representation skill. It can improve students’ mathematical representation ability better than the conventional learning model. The high, medium, and low social skills influenced the improvement of students’ mathematical representation skill. The mathematical representation skill of students with high social was better than students with moderate and low social skills. Furthermore, there was no interaction between the learning models and social skill categories toward the improvement of students’ mathematical representation skill.

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