Application of the Self Organized Learning Environment Learning Model in Mathematics Learning Arithmetic Sequence Material

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Abstract
The objective of this study is to analyze the disparities in the mean learning achievements between students who utilize the SOLE learning model and those who employ the direct learning model for arithmetic sequence material at Tondano State Vocational School. The research employed a quasi-experimental design with a Posttest Only Control Group Design. The participants in this study consisted of students from class X OTKP 1, who were assigned to the experimental group, and students from class X OTKP 2, who were assigned to the control group. The data gathering method involved administering a technical learning outcomes test at the conclusion of the class (Posttest). The data analysis technique employed in this research utilizes tests on data that has undergone normality and homogeneity testing. The t test calculations yielded a t_count value of 2.736, which exceeded the critical t_table value of 1.685. Therefore, the null hypothesis (H₀) was rejected, and the alternative hypothesis (H₁) was accepted. Therefore, it can be inferred that there is a disparity in the mean learning results of students in the Self-Organized Learning Environment (SOLE) instructional approach and the traditional direct learning approach when it comes to arithmetic sequence material.

Keywords: Learning Model, SOLE Model, Numeracy Ability, Arithmetic Mathematics

INTRODUCTION
Students’ motivation could be better in studying Mathematics because the learning model is less interesting and makes students more passive in the teaching and learning process. According to Oemar (Fatimah, 2017), so that students have great motivation to learn mathematics, there are several strategies used by mathematics teachers to motivate their students (Febriyanti & Seruni, 2015; Rahmayani & Hamdana, 2022). Teachers can increase motivation by arousing student interest, maintaining curiosity, using various presentations, and giving students opportunities to determine their own goals (Rahmayani & Amalia, 2020; Firdaus et al., 2021).

Learning carried out in class now requires students to act and be involved actively and
creatively in every learning activity. Therefore, teachers should need interesting learning designs (Andriani & Wakhudin, 2020; Hakim & Windayana, 2016). Based on observations made at SMK Negeri 2 Tondano in the 2020/2021 semester two academic year, teaching and learning activities at this school are still focused on teachers, and students are still relatively passive due to the lack of interesting learning methods applied, so that students are not creative in solving mathematical problems of arithmetic sequences. (Hamili, 2015). The National Council of Teachers of Mathematics (NCTM) states that creative people in mathematics tend to have an interest and appreciation for doing mathematics and tend to think and act positively (Kejarcita, 2021). These tendencies include a strong desire to choose strategies for solving mathematical tasks, self-confidence, motivation to see alternative solutions, diligence, curiosity, and a tendency to reflect on their way of thinking (Lolombulan, 2017; Eva et al., 2023).

Based on my experience during Field Experience Practice (PPL) at SMK Negeri 2 Tondano, student learning outcomes in solving arithmetic series material still needed to be higher. Therefore, it is necessary to have an interesting learning model so that students are active and creative in learning. The solution to the problem above is to use innovative learning in order to improve student learning outcomes in solving problems. Innovations that teachers can make to develop learning are by using effective learning media so that students can easily understand learning (Hakim, A. R., & Windayana, 2016; Marlina, 2021).

In this era, technology is also very important in education, especially in the teaching and learning process. According to (Fatimah & Santiana, 2017), technology applications can influence student behavior towards being more interested in teacher teaching. There needs to be a learning model using technology so that students are more interested in learning mathematics (Lestari, 2015; Wahid et al., 2021). One of the steps that can be taken to achieve optimal learning goals is to apply the Self Organized Learning Environments (SOLE) learning model (Suciati, 2021; Rofingah, 2021; Mariana & Hidayanto, 2022).

Self-organized learning environments (SOLE) are learning methods introduced by Professor Sugata Mitra. Professor Sugata Mitra is an Indian National Educational Technology Practitioner from England (Nur, 2019). In 2013, Professor Sugata Mitra, through a conversion presentation at a TED Talk, introduced the SOLE method (Rofingah, 2021). Self-organized learning Environments (SOLE) are a learning model that places students in an independent and self-organized learning environment (Wati, 2020). In the SOLE learning model, a group of students are given internet access, and they are asked to study on their own and look for answers to questions asked by the teacher. According to Mitra (Watung et al., 2022), the founder of the SOLE concept, SOLE is designed to help students gain knowledge through interaction with peers and independent exploration without direct guidance from teachers. In a SOLE environment, students are given an open-ended question or challenging problem and are asked to work together to find a solution. Technology such as computers and the internet are used to help students find the information they need to answer questions or solve problems.
There are three stages in implementing the SOLE learning model, namely, questions, investigations, and reviews. At the question stage, the teacher asks questions that can arouse students’ curiosity about the material being taught. Then, in the investigation stage, students form small groups and work together using their internet devices to find answers to the questions given previously. Next, at the review stage, each group presents the results of their discussion (Wati, 2020). These three stages mean that the application of the SOLE learning model can direct students to truly learn and understand material independently by being technologically literate and ready to communicate it to others (Firdaus, 2021). Based on this explanation, the researcher considers it necessary to carry out research with the title Application of the Self-Organized Learning Environment (SOLE) Learning Model to the Ability to Count Arithmetic Sequences at SMK Negeri 2 Tondano.

**METHOD**

This research uses quantitative research, which aims to test hypotheses from data collected from previous theories and concepts. This research is experimental research that compares the experimental class with the application of the SOLE learning model and the control class with the application of the direct learning model. The experiment used in this research is a quasi-experiment or quasi-experiment because the researcher applies action in the form of a learning method. The experimental design in this research is the Posttest-Only Control Group Design research design, as in the table below.

<table>
<thead>
<tr>
<th>Class</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eksperimen</td>
<td>P₁</td>
<td>Y₁</td>
</tr>
<tr>
<td>Kontrol</td>
<td>P₂</td>
<td>Y₂</td>
</tr>
</tbody>
</table>

Information:

P₁ = Approach using the SOLE learning model
P₂ = Approach using a direct learning model
Y₁ = Learning outcome score using the SOLE learning model
Y₂ = Score of learning outcomes using the direct learning model

The location of this research will be SMK NEGERI 2 TONDANO. Research with the material Arithmetic Sequences will be carried out in the even semester of 2022/2023. The population of this study was taken at the active SMK Negeri 2 Tondano. Samples were taken using simple random sampling. Simple random sampling is a sampling technique that is carried out randomly by members of a population without paying attention to the strata (levels) in that population. The variables in this research are the SOLE learning model used in the experimental class and the direct learning model in the control class. Learning outcomes achieved after being given treatment. The learning outcomes in question are the post-test scores in the experimental and control classes.

An instrument is a tool or means used in collecting data to make the work easier and the results
better, in the sense of being more accurate, complete and systematic so that it is easier to process. The instruments used in this research are as follows:

1. Observation guidelines

Tools used to collect data and record the phenomena being investigated.

2. Test guidelines

The test used is a written test in the form of a description to determine students’ knowledge, especially regarding arithmetic sequence material.

3. Documentation guidelines

Documentation guidelines are used to collect documented written objects.

This research uses essay test questions given at the end of the lesson as the data collection technique. Before the test instrument is used, a reliability and validity test is carried out.

Table 2 Test Instrument Grid regarding Arithmetic Sequence material

<table>
<thead>
<tr>
<th>No.</th>
<th>Indikator</th>
<th>Question</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Determine the tribe</td>
<td>1</td>
<td>Description</td>
</tr>
<tr>
<td>2</td>
<td>Determine the difference</td>
<td>2 and 4</td>
<td>Description</td>
</tr>
<tr>
<td>3</td>
<td>Solving problems from story problems</td>
<td>3</td>
<td>Description</td>
</tr>
<tr>
<td>4</td>
<td>Determine the formula for the nth term</td>
<td>5</td>
<td>Description</td>
</tr>
</tbody>
</table>

In this research, the normality test is used to determine whether the distribution is normal or not. To test normality in this research, the Kolmogorov-Smirnov (KS) test was used (Lolombulan, 2017).

\[ D_{count} = \text{maximum} \left| F_t - F_s \right| \text{ with Kolmogorov-Smirnov table} \]

Note:

\( F_t = \) Normal cumulative probability

\( F_s = \) Empirical cumulative probability

If the normality test is not normal using the data above then it is carried out using the Kolmogorov-Smirnov test as follows:

Steps to perform the Kolmogorov Smirnov Test:

1. Determine the hypothesis

\( H_0: \) data comes from a normal distribution

\( H_1: \) data comes from a distribution

2. Determine the average of the data

3. Calculating the standard deviation: \[ SD = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} \]

4. Calculating the z score is \( Z = \)

5. Find \( F_t \), by looking at the normal distribution table

6. Determine \( F_s \), by: \[ \frac{\Phi_{kam}}{n} \]

7. Determine \( \left| F_t - F_s \right| \)

Test conclusion:
Test conclusions are obtained by comparing values
\[ D = \max \left| F_{t} - F_{s} \right| \] with D table.

The homogeneity test is used to see two or more groups of sample data from a population that have the same variations, used on posttest data for the experimental class and control class. To measure the homogeneity of variation in the two groups, the F test formula is used, namely:
\[ F = \frac{\text{largest variance}}{\text{smallest variance}} \]

The significance level used is \( \alpha = 0.05 \). Homogeneity test using the Microsoft Excel application with the criteria used to draw conclusions if \( F_{\text{count}} \) is greater than \( F_{\text{table}} \) then the variance is homogeneous. However, if \( F_{\text{count}} \) is smaller than \( F_{\text{table}} \), then the variance is not homogeneous (Lolombulan, 2017).

For statistical hypothesis testing, the test that will be used is the comparison test of the means of two unpaired groups or the unpaired test. Before testing the hypothesis, a previous normality test and homogeneity test will be carried out (Lolombulan, 2017).

The statistical hypothesis is:

- \( H_0: \mu_1 = \mu_2 \) (the average learning achievement score for the experimental class is the same as the average learning achievement score for the control class)
- \( H_1: \mu_1 > \mu_2 \) (the average learning achievement score for the experimental class is more than the average learning achievement score for the control class)

If the data for both groups is normally distributed, the t test formula is as follows:
\[ t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \]

\[ S = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2}} = \text{standard deviation of the two groups combined} \]

\[ t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \] if the variances of the two groups are different.

Criteria \( H_1 \) is accepted and \( H_0 \) is rejected

Information:
- \( t \) = average value
- \( S \) = standard deviation
- \( \bar{x}_1 \) = average value of experimental class learning outcomes
- \( \bar{x}_2 \) = average value of control class learning outcomes
- \( S \) = combined variance
- \( s_1^2 \) = experimental class variance
- \( s_2^2 \) = control class variance
- \( n_1 \) = number of experimental class students
- \( n_2 \) = number of control class students

If the data is not normally distributed then a non-parametric test will be carried out, namely the Mann
Whitney U test which has the following Z distribution approximation formula:

\[ Z_{\text{count}} = \frac{U - n_1 n_2}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}} \]

With:

\[ U = n_1 n_2 + \frac{n_1 (n_1 + 1)}{2} - R_1 \text{ or } U = n_1 n_2 + \frac{n_2 (n_2 + 1)}{2} - R_1 \]

The results of \( n_1 \) and \( n_2 \) are the number of observations in group A and group B.

Information:

\( R_1 \) = number of ranking values in group A

\( R_2 \) = number of ranking values in group B

RESULT AND DISCUSSION

Based on the results of research conducted at SMK Negeri 2 Tondano on class This research was carried out using two classes as subjects, namely class X OTKP 1 as an experimental class using the SOLE learning model and class X OTKP 2 as a control class using a direct learning model. Data obtained through research instruments aims to answer the problem formulation.

Researchers took research data from the final test (Post-test) of experimental class and control class students on arithmetic sequence material using posttest questions that had been tested for validity and reliability. In general, student learning outcome data is presented in the table below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Statistic</th>
<th>Statistic Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Experiment Class</td>
</tr>
<tr>
<td>1</td>
<td>Minimum Score</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>Maximum Score</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>Total</td>
<td>1675</td>
</tr>
<tr>
<td>4</td>
<td>Average</td>
<td>83.75</td>
</tr>
<tr>
<td>5</td>
<td>Standard Deviation</td>
<td>6,042612</td>
</tr>
<tr>
<td>6</td>
<td>Variance</td>
<td>36,51316</td>
</tr>
</tbody>
</table>

Based on Table 3, the experimental class score is higher than the control class score. The normality test used to test whether the data was normally distributed or not in the research was the Kolmogorov-Smirnov test using the Microsoft Excel 2010 application.

The statistical hypotheses tested are as follows:

\( H_0 \): Data on student learning outcomes in the experimental class is normally distributed.

\( H_1 \): Student learning outcomes data in the experimental class is not normally distributed.

\( H_0 \): Data on student learning outcomes in the control class is normally distributed.

\( H_1 \): Student learning outcomes data in the control class is not normally distributed.

With the decision criteria, if the largest \( |F_r-F_s| \) < Kolmogorov Smirnov table value, then \( H_0 \) is accepted; \( H_0 \) is rejected, and if the largest \( |F_r-F_s| \) > Kolmogorov Smirnov table value, then \( H_0 \) is
rejected; $H_a$ accepted.

Table 4. Normality Test Results Data

<table>
<thead>
<tr>
<th>Class</th>
<th>D grade</th>
<th>KS table values</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class X OTKP 1</td>
<td>0.132566</td>
<td>0.294</td>
<td>Accept $H_0$</td>
</tr>
<tr>
<td>(Experimental Class)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class X OTKP 2</td>
<td>0.202745</td>
<td>0.294</td>
<td>Accept $H_0$</td>
</tr>
<tr>
<td>(Control Class)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 shows that the two classes have the largest $|F_r-F_s|$ value < Kolmogorov Smirnov table value, so it can be concluded that the learning outcomes data for class X OTKP 1 and OTKP 2 are normally distributed. The homogeneity test was carried out to determine whether the experimental class and control class had the same variance or not. Following are the statistical results of the F-test.

Table 5. Homogeneity Test

<table>
<thead>
<tr>
<th>Class</th>
<th>Variance</th>
<th>$F_{count}$</th>
<th>$F_{table}$</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class X OTKP 1</td>
<td>37.10526</td>
<td>1.016216</td>
<td>2.168252</td>
<td>Accept $H_0$</td>
</tr>
<tr>
<td>(Experimental Class)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class X OTKP 2</td>
<td>36.51316</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Control Class)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 shows that $F_h = 1.016216 < F_t = 2.168252$ so $H_0$ is accepted. So, it can be considered that the variance of the experimental class and control class data is homogeneous or the same. Based on the results of testing the normality and homogeneity of the experimental class and control class, the data obtained were distributed normally and homogeneously, so that hypothesis testing could be continued using $t$. With a statistical hypothesis, namely:

$H_0 : \mu_1 = \mu_2$ (the average learning achievement score for the experimental class is the same as the average learning achievement score for the control class).

$H_1 : \mu_1 > \mu_2$ (the average achievement learning outcome score for the experimental class is more than the average achievement learning outcome score for the control class).

Table 6. Hypothesis Testing

<table>
<thead>
<tr>
<th>Class</th>
<th>$t_{count}$</th>
<th>$t_{table}$</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class X OTKP 1</td>
<td>2.736</td>
<td>1.685</td>
<td>Accept $H_0$</td>
</tr>
<tr>
<td>(Experimental class)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class X OTKP 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Control class)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 shows that $t_{count} > t_{table}$, then $H_1$ is accepted, and $H_0$ is rejected (at $\alpha = 0.05$). This shows that there is an influence in the experimental class with the average learning outcomes of students taught using the SOLE learning model more than in the control class using the direct learning model.

The results of the research given to experimental class and control class students show that there are differences in learning outcomes. These results show that the average learning outcome score for
the experimental class is more than the average learning outcome score for the control class. The highest score achieved in the experimental class was 95, and the highest achieved in the control class was 85. This shows that the average learning outcome score in the experimental class was better than that of the control class, with the highest score being in the experimental class, which used the SOLE model.

Based on the results of calculations with a significance level of 0.05, $t_{\text{count}} = 2.736$ and $t_{\text{table}} = 1.685$. Because $t_{\text{count}} = 2.736 > t_{\text{table}} = 1.685$, then $H_0$ is rejected, and $H_1$ is accepted. Thus, the SOLE learning model influences the Arithmetic Sequence material. So it can be used as a development of learning outcomes at SMK Negeri 2 Tondano. According to Marlina’s research results (2021), the presentation of learning outcomes for science subjects in cycle 1 was 62%, and the presentation in cycle 2 was 87.5%. So, the SOLE learning model can improve learning outcomes for online science subjects from cycle 1 to cycle 2 by 25%.

Based on the difference test between the two average learning outcomes for the experimental class, which is higher than the control class, it can be concluded that the average learning outcomes for mathematics in arithmetic sequences using the SOLE learning model are higher than the average learning outcomes using the learning model direct.

CONCLUSION

Based on the research results and discussion described above, it can be concluded that student learning outcomes using the SOLE learning model are higher than those using the Direct learning model on Arithmetic Sequence material, so it can be used as an alternative learning media at SMK Negeri 2 Tondano.

REFERENCES


