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# The Influence of Problem Based Learning Model with Flipped Classroom on the Mathematical Literacy Ability of Class VIII Students at SMPN 19 Seluma

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## Abstract

The mathematical literacy of Class VIII at SMP Negeri 19 Seluma is relatively low, as evidenced by the initial literacy test results. This study aims to determine the effect of applying the problem-based learning model with a flipped classroom on the mathematical literacy skills of Class VIII students at SMP Negeri 19 Seluma. This research is a quasi-experimental study using a non-equivalent posttest-only control group design. The population of this study consists of all Class VIII students at SMP Negeri 19 Seluma for the 2023/2024 academic year. The research sample includes Classes VIII A and VIII B, selected using the purposive sampling technique, with the sample consisting of all students in these two classes. The instrument used was a mathematical literacy test sheet with descriptive questions. The results indicate that the average posttest scores of the experimental group were above the completion criteria, while the control group's posttest scores were below the completion criteria. The Mann-Whitney test showed a significant value less than the alpha level (α), or z_count>z_table, leading to the conclusion that there is a significant effect of the problem-based learning model with a flipped classroom on the mathematical literacy skills of Class VIII students at SMP Negeri 19 Seluma.

**Keywords:***Mathematical Literacy, Problem Based Learning with Flipped Classroom*

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## Introduction

Mathematics is one of the basic sciences that plays an important role both in everyday life and in the development of science and technology (Anwar, 2018). The importance of mathematics is not only studied in schools, but mathematics is also closely related to daily life activities. Mathematics learning in schools is expected to achieve the goals of mathematics learning. As stated in Permendikbud Number 36 of 2018 concerning the objectives of mathematics learning. According to Indah et al (2016) there are several objectives of mathematics including to train how to think and reason in drawing conclusions, develop creative activities that involve imagination, intuition and invention, develop problem-solving skills, and develop the ability to convey information or communicate ideas.

The National Council of Teacher of Mathematics or NCTM (2000) sets five mathematical abilities in the core standards of mathematics learning, namely: first, communication skills; second, reasoning skills; third, problem solving skills; fourth, connection skills; and fifth, representation skills. These five mathematical abilities are able to develop self-potential to be able to follow and compete in global life (Abidin et al, 2018, p. 99). In addition, the abilities that cover the five core standards of mathematics learning can be expressed in mathematical literacy (Yanwari et al, 2019, p. 390).

Literacy comes from the English word 'literacy', which means the ability to read and write (Anjani et al., 2012, p. 1). The ability to read or write is the main competency needed by humans in carrying out daily activities (Anjani et al., 2012, p. 1). Based on several surveys, the literacy culture of Indonesian society is still very low (Aminah, 2014). There are various types of literacy, one of which is mathematical literacy. According to Anwar (2018, p.38) explains that mathematical literacy is an ability possessed by individuals by using their mathematical knowledge to solve problems in everyday life effectively. Literacy in mathematics learning is needed in the problem-solving process where students are required to solve problems sequentially (Amalia, 2017, p.38). So in the problem-solving process, it does not only require the ability to calculate but also how to communicate, reason, and other mathematical thinking processes, therefore students are required to be able to have these various abilities.

Mathematical literacy skills are very much needed by students to face and solve various challenges of today's life (Anwar, 2017, p.38). Given the importance of literacy skills as something that is very important, efforts can be needed to improve and develop these skills for the advancement of Indonesian education so that they can compete with other countries in the

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world (Afriyanti. et al, 2017). So in this case, mathematics learning has a very important role to be able to follow the contribution in efforts to improve and develop students' mathematical literacy skills.

According to Fatwa & Septian, (2019, p.390) it can be explained that mathematical literacy can be defined as a person's ability to develop, use, and interpret mathematics in various contexts, including the ability to reason mathematically and use concepts, procedures, and facts as tools to describe, explain, and predict phenomena or events. In the demands of students' abilities in learning mathematics, they not only have the ability to count, but also the ability to reason logically and critically in solving a problem (Astria et al., 2023, p.107). Such mathematical abilities are known as mathematical literacy abilities (Sari, 2015). Mathematical literacy is one of the 21st century skills needed. The factors that influence the achievement of mathematical literacy in Indonesia are: individual factors, pedagogical factors and environmental factors. One of the personal factors is the intelligence possessed by students (Nilasari & Anggreini, 2019, p. 208).

In fact, the mathematical literacy skills of students in Indonesia are still relatively low, this can be proven based on the results of PISA in 2022. So from the data that has been obtained, it turns out that Indonesia in 2022 is still ranked 68th with an average score of 379. Another fact that students in Indonesia have low mathematical literacy skills can be proven from the results of research conducted by Indah, et al (2016, p. 390) the results of their research show that students in Indonesia have low mathematical literacy skills, this happens because of the inability of students to solve problems in the form of formulating, applying, and even interpreting mathematics in various contexts.

Based on the results of observations and interviews conducted by researchers on December 21, 2023 with one of the mathematics teachers at SMP Negeri 19 Seluma, it was found that SMP Negeri 19 Seluma uses the 2013 curriculum. The mathematical literacy skills of grade VIII students still tend to be low. This can be proven by the fact that there are still students who have not reached the minimum completion criteria of 75 on one of the initial ability test results. It can be seen from the fact that there are still students who get the lowest score of 20, where this score is less than the minimum completion criteria, while students who get the highest score are 50. This is because students are not used to solving problems that require aspects of understanding, reasoning, planning, formulating, solving, and finding results.

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However, students are used to working on problems by just copying, without first understanding the meaning of the questions given.

Many studies have shown that mathematical literacy skills are still relatively low. According to Aini (2013, p.57) in her research, she stated that the mathematical literacy skills of junior high school students are still relatively low. The low mathematical literacy of students in Indonesia is due to the selection of learning models that are applied which are still not quite right (Septiana & Iksan, 2017). The learning model currently applied is a conventional learning model and is centered on the teacher so that the teacher is more active than the students in the learning process (Damayanti et al., 2020, p. 85). This can cause students to get used to the learning that takes place in the classroom, so that students only wait and listen to the information conveyed by the teacher (Pratiwi et al, 2017). Given the importance of mathematical literacy, students are required to have this ability well. One of the efforts that can be made by educators to improve students' mathematical literacy skills is to create innovative mathematics learning by selecting the right learning model (Wardono, 2015, p. 94). One of the learning models that can be applied is the problem-based learning model (Damayanti et al., 2020, p. 86)

The use of the problem-based learning model has been considered to be able to influence students' mathematical literacy skills. Research conducted by (Istiandaru et al., 2015; Priyonggo et al., 2019; Sri et al, 2018, p.852) has shown that the use of problem-based learning is effective in improving students' mathematical literacy skills. Meanwhile, (Astuti, 2020; Aula et al., 2019; Dewi & Listiyani, 2018; Wicaksono & Agustyaningrum, 2018, p.852) have identified that the mathematical literacy skills of students taught using the problem-based learning model are not better than the literacy skills of students taught using the conventional approach. In addition, the problem-based learning model takes a long time (Agustin & Mayasari, 2022). So, from the statement above, it can be concluded that the use of the problem-based learning model is not better than the use of conventional learning, besides it also takes a long time. Therefore, to overcome this, a problem-based learning model is needed which is combined with the flipped classroom model.

The problem-based learning model is a learning process that focuses on students to be active during learning (Pamungkas & Franita, 2019, p. 76). According to Lestari & Yudhanegara (2015, p. 42), problem-based learning is a learning model that challenges students to learn, how to learn to work in groups to find solutions to real-world problems. In this model,

the learning process students are trained to solve problems by interpreting the ideas they have in the form of mathematical symbols (Agustin & Mayasari, 2022, p. 30). In this problem-based learning model, students do not only work alone in solving problems but students work in discussions which are formed in groups consisting of 5-6 students, so that students can interpret the ideas they have in the form of mathematical symbols accurately and logically (Agustin & Mayasari, 2022, p. 30).

Flipped classroom is a learning method where the provision of material and assignments are reversed (Pantade & Eko, 2021). In a flipped classroom, the learning process that includes the provision of material is carried out at home, while assignments are done in the classroom during mathematics learning. Learning in a flipped classroom can be done online and offline (face-to-face). According to (Kurniawati et al., 2019) in online learning, students can study learning resources that have been provided by the teacher independently. While in face-to-face learning it can be used for group discussions, practicing skills, honing deeper understanding of the material (Savitri & Meilana, 2022). And discussing material or problems that students do not yet understand (Yulietri et al., 2015, p.6)

Based on this, the problem-based learning model with the flipped classroom is expected to improve students' mathematical literacy skills (Damayanti et al., 2020, p.86). According to research (Reynawati & Purnomo, 2018) states that the problem-based learning model is able to develop reasoning skills in inductive and deductive analytical thinking in using concepts. Based on research (Çakiroğlu & Öztürk, 2017) states that the problem-based learning model with the flipped classroom is a problem-based learning activity carried out in a flipped classroom. Activities from the results of Syamsuri's research (2019) obtained that the flipped classroom model has an effect on learning independence which can be viewed from students' cognitive styles. Flipped classroom or flipped class is a type of blended learning that collaborates learning through face-to-face with learning through independent learning (Gawise et al., 2021, p.7). This is further explained by Adhitiya et al., (2015, p.2) that in flipped classroom learning, students watch learning videos at home to find the concept of the subject matter themselves according to their own speed. The problem-based learning model with flipped classroom is a combined model that utilizes learning technology and can support authentic learning (Chis et al., 2018).

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Based on the description, the researcher is interested in conducting a study entitled "The Effect of Problem Based Learning Model with Flipped Classroom on Mathematical Literacy of Class VIII Students of SMP Negeri 19 Seluma".

## Research Method

The type of research used in this study is a quasi-experimental research type (Quasi Experiment). Experimental research is defined as a research method used to find the effect of certain treatments on others under controlled conditions (Kamaruddin et al., 2022, p.267). According to Sugiyono (2014, p.114) a quasi experiment is a study that has a control group, but does not function fully to control external variables that affect the implementation of the experiment.

In this Quasi Experiment research, it is used to determine the effect of the problem based learning model with flipped classroom on the mathematical literacy skills of class VIII students of SMP Negeri 19 Seluma. In this study, the type of nonequivalent posttest-only control group design can be used.

**Table 1. Nonequivalent Posttest – Only Control Group Research Design**

| Group | Treatment | Posttest |
|---|---|---|
| Experiment | X | O |
| Control | - | O |

(Lestari & Yudhanegara, 2018, p. 138)

Information :

O = Posttest, to measure learning outcomes in the experimental class

O = Posttest, to measure learning outcomes in the control class

$X$ =Treat the experimental group with a problem based learning model with a flipped classroom

Hypothesis testing aims to determine the truth of the temporary hypothesis that has been made. In this study, the hypothesis is formulated with a hypothesis using parametric analysis, but if the data is not normally distributed, the hypothesis test is carried out using non-

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parametric analysis. Hypothesis testing is used to test whether there is an effect of the problem-based learning model with flipped classroom on students' mathematical literacy. The student learning outcome test data obtained in this study were analyzed with the aim of determining the final results of the study, whether they were accepted or not. Thus, the following hypothesis can be formulated:$H_0H_1$

$H_0 : \mu_1 = \mu_2$

(There is no positive influence of the problem based learning model with flipped classroom on the mathematical literacy of class VIII students of SMP Negeri 19 Seluma).

$H_1 : \mu_1 > \mu_2$

(There is a positive influence on the problem based learning model with flipped classroom on the mathematical literacy of class VIII junior high school students.

Country 19 Seluma)

Information:

$\mu_1$:The average posttest of students in the experimental class using the problem based learning model with flipped classroom.

$\mu_2$ :The average posttest of control class students using conventional learning methods.

To conduct hypothesis testing with T-test samples, the data obtained must be tested for its prerequisites first. In data that is normally distributed and has homogeneous variance, the analysis used is parametric statistics. While in data that is not normally distributed or has non-homogeneous variance, the analysis used is non-parametric statistical analysis.

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The hypothesis test used in this study is the t-test (paired t-test) with homogeneous variance for the dependent sample.

The testing steps are:

1. Testing data normality: the data is known to be normally distributed so there is no need to re-test.
2. Assessing data homogeneity: the variance of both data is known to be homogeneous so there is no need to re-test.
3. Formulating a hypothesis
4. Determining the value of a statistical test using a formula$t_{hitung} = \frac{\bar{x}_D}{\sqrt{\frac{\sum d^2}{N\,(N-1)}}}$,where D = difference between data pairs (difference),$\bar{x}_D$ — the average of the differences of the data pairs, d = D -$\bar{x}_D$,and N = amount of data.
5. Determine the critical value using the formula:
   $t_{tabel} = t_{(a,dk)}$, where is the level of significance and dk = degrees of freedom (dk = n-1).$a =$
6. Determining hypothesis testing criteria
7. Providing a conclusion, the criteria for testing a hypothesis are accepted if, with a real level and degree of freedom$H_0 t_{tabel}$ $((n_1 + n_2 - 2))5\%$ $(a = 0{,}05) db = n_1 + n_2 - 2$

Hypothesis testing if the data is normally distributed and the variance is homogeneous, then a statistical test can be used using the following formula:

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$$t_{hitung} = \frac{\bar{x}_D}{\sqrt{\frac{\sum d^2}{N\,(N-1)}}}$$

(Kadir, 2016)

Information :

D : Difference in posttest data

$\bar{x}_D$ : The average of the posttest data differences

d : D -$\bar{x}_D$

N : Lots of data

Hypothesis testing criteria are accepted if and rejected, with a real level and degrees of freedom. Hypothesis testing can also be done using SPSS software with the testing criteria being if the significance value <real level then rejected and if the significance value > level, then accepted (Lestari & Yudhanegara).$H_0 t_{hitung} \geq t_{tabel}\,((n_1 + n_2 - 2))H_0 t_{hitung} \geq t_{tabel}\,((n_1 + n_2 - 2))5\%\,(a = 0{,}05)db = n_1 + n_2 - 2(a) = 0{,}05H_0(a) = 0{,}05H_0$

While in data that is not normally distributed or the variance is not homogeneous, the analysis used is non-parametric statistical analysis of the Mann-Whitney test. The Mann-Whitney test is the strongest test among other non-parametric tests of two independent samples (Rao, 2007). Hypothesis testing if the data distribution is not normal, then use the following formula:

For samples of size , testing can be approached with a normal distribution (Arini, 2011; Riadi 2015)$n_1, n_2 > 20$

- If there are no identical observation values (ties) use the formula

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$$Z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}}$$

(Riadi, 2015, p. 80)

- If there are the same observation values (ties) use the formula:

$$Z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\left(\frac{n_1 n_2}{(n_1 + n_2)(n_1 + n_2 - 1)}\right)\left(\frac{(n_1 + n_2)^3 - (n_1 + n_2)}{12} - \sum T\right)}}$$

(Riadi 2015, p. 80)

Information :

$n_1$ : sample size 1

$n_2$ : sample size 2

$T$ : $\frac{t^3 - t}{12}$

$t$ : number of identical observation values/twin values

The test rule is based on comparing with . The decision rule if or then is rejected.$z_{hitung}\ z_{tabel}\ z_{hitung} > z_{tabel}\ z_{hitung} < -z_{tabel}\ H_0$

## Results and Discussion

### A. Requirements Analysis Test

Analysis requirement test is a test conducted to investigate the requirements before conducting a hypothesis test. Analysis requirement test includes normality test and homogeneity test against posttest.

### B. Normality Test

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The normality test aims to determine whether the posttest value data from each sample class is normally distributed or not. The normality test used in this study is the Shapiro Wilk test processed using SPSS 25 software, with the following hypothesis:

$H_0$ =Data is normally distributed

$H_1$ =Data is not normally distributed

Normality testing is carried out to determine whether the data distribution is normally distributed or not. Because the sample in this study is small, the normality test in this study was carried out using the Shapiro Wilk test and skewness value with the help of SPSS 25. Testing criteria$H_0$accepted if the calculated Shapiro Wilk value (p) > Shapiro Wilk real level (rejected if the calculated Shapiro Wilk value is less than the Shapiro Wilk table (The results of the normality test using SPSS 25 can be seen in the following table:$\alpha = 5\% = 0{,}05). H_0 p <$ 0,05).

**Table 2. Normality Test Results**

| Posttest Data | Shapiro Wilk | | Information |
|---|---|---|---|
| | Real Level | Significance | |
| Experimental Class | 0.05 | 0.298 | Normal Data |
| Control Class | | 0.020 | Abnormal Data |

Based on table 2, it can be seen that the calculation using the SPSS 25 application, the posttest data of the experimental class and the control class are not normally distributed. The results of the calculation of the posttest data of the experimental class obtained a significance value of , and the posttest data of the control class obtained a significance value of . Thus, it can be concluded that hypothesis testing can be done with non-parametric statistical calculations.$0{,}298 > 0.050{,}020 > 0{,}05$

**C. Homogeneity Test Results**

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The homogeneity test is conducted to show that the sample data group comes from a population that has the same variance. The calculation of the homogeneity test in this study uses the Fisher test with the help of Ms. Excel and SPSS 25 software. The hypotheses proposed are as follows:

$H_0$ =The sample comes from a homogeneous population
$H_1$ =The sample comes from a non-homogeneous population

The homogeneity test criteria are if with a real level then the posttest data of the experimental class and the control class are homogeneous. While if with a real level then the posttest data of the experimental class and the control class are not homogeneous.$F_{hitung} < F_{tabel}\alpha = 0{,}05, F_{hitung} \geq F_{tabel}\alpha = 0{,}05,$

Homogeneity testing is carried out using SPSS 25 software with acceptable criteria if the calculation result value is obtained as follows:$H_0 sig > \alpha = 0{,}05.$

**Table 3. Homogeneity Test Results**

| Real Level ()$\alpha$ | Sig Value | Information |
|---|---|---|
| 0.05 | 0.099 | Homogeneous |

The calculation result shows that the sig value so it can be concluded that it is accepted. So, based on the f test and Levene's Test above that it is accepted so it can be concluded that the posttest data of the experimental class and the control class of class VIII are homogeneous.$= 0{,}099 > 0{,}05, H_0 H_0$

**D. Results of Research Hypothesis Testing**

Hypothesis testing aims to determine whether there is an influence on the problem based learning model with flipped classroom on students' mathematical literacy. Hypothesis testing in this study was carried out with the help of SPSS 25 Software with the Mann Whitney test. The Mann Whitney test was carried out because the data was not normally distributed.

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The hypothesis in this study is that there is an influence of the problem based learning model with flipped classroom on mathematical literacy of class VIII SMP Negeri 19 Seluma. Based on the research hypothesis, the statistical hypothesis to be tested is:

$H_0 : \mu_1 = \mu_2$

(There is no influence of the problem based learning model with flipped classroom on mathematical literacy of class VIII SMP Negeri 19 Seluma).

$H_0 : \mu_1 > \mu_2$

(There is an influence of the problem based learning model with flipped classroom on mathematical literacy of class VIII SMP Negeri 19 Seluma).

Information :

$\mu_1$:The average posttest score of students in the experimental class using the problem based learning model with flipped classroom.

$\mu_2$:The average posttest score of students in the control class using the conventional learning model.

Hypothesis testing in this study was carried out with the help of SPSS 25 Software with testing criteria, if the sig value is rejected. The results of the calculation with SPSS are shown.$<$ $\alpha = 0{,}05 H_0$

**Table 4. Hypothesis Test Results (Mann Whitney)**

| $z_{hitung}$ | $z_{tabel}$ | Significance | Level | Information |
|---|---|---|---|---|
| 4.056 | 1.30 | 0.00 | 0.05 | $H_0$rejected |

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Based on table 4. it can be seen that the significance value or namely and the significance value of the real level, so it can be concluded that rejected means accepted. So, based on the results of the Mann Whitney test with SPSS 25, it shows that there is a significant influence on the problem based learning model with flipped classroom on mathematical literacy of class VIII students of SMP Negeri 19 Seluma. $0{,}00 < 0{,}05 z_{hitung} > z_{tabel}$ $4{,}056 > 1{,}30$ $H_0 H_1$

The problem based learning model with flipped classroom has an effect on students' mathematical literacy. This is shown from the results of the hypothesis test where the sig value <real level and which shows that the average value of the experimental class students is higher than the average value of the control class. In line with the research $z_{hitung} > z_{tabel}$(Damayanti et al., 2020)There is a very significant difference between the creative thinking of students in the experimental and control classes. This proves that the problem-based learning model with flipped classroom is effective in improving student learning outcomes because with this learning model, students actively have the opportunity to build, construct, and optimize knowledge independently.

This is in line with research conducted(Sinmas et al., 2019)The type of quasi-experimental research with a non-equivalent posttest control group research design shows that there is a higher average value of the experimental class than the average value of the control class. The results of the study indicate that the average posttest results related to achievement in terms of student learning motivation are 86 and 83, then a paired t-test is carried out and the value obtained is 6.24> 3.91, so it can be concluded that there is a significant influence of the problem based learning model with flipped classroom on achievement abilities in terms of student learning motivation$t_{hitung} > t_{tabel}$(Sinmas et al., 2019).

This shows that the application of the problem based learning model with flipped classroom can have an effect on students' mathematical literacy because this learning consists of several. The first stage of learning using flipped classroom where students watch learning videos first before learning in class after that learning in class using problem based learning. The stage of using the problem based learning model in class using LKPD teaching materials consisting of student orientation to the problem, at this stage the teacher informs the learning objectives, describes important logistical needs, and motivates to be involved in self-selected problem solving activities.

## Conclusion

Based on the results of the research that has been conducted, it can be concluded that there is an influence of the problem based learning model with flipped classroom on the mathematical literacy of class VIII students of SMP Negeri 19 Seluma.

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