Treffinger Learning to Enhance Statistical Literacy Primary Student

Nur Rohmah Emilia[1], Mohammad Faizal Amir[2*]
[1]Primary School Teacher Education Department, Universitas Muhammadiyah Sidoarjo, Sidoarjo
[2*]Primary School Teacher Education Department, Universitas Muhammadiyah Sidoarjo, Sidoarjo
e-mail: nurrohmah.umsida@gmail.com, faizal.amir@umsida.ac,id

Abstract

Statistical literacy is a primary need for primary students as to skills in interpreting statistical data, and analyzing and solving statistical problems in the 21st century. However, statistical literacy for primary students is still inadequate. Moreover, there is still a lack of treffinger learning literature on statistical literacy for primary students. Consequently, this study seeks to investigate the effect of treffinger learning on enhancing the statistical literacy of primary students. This experimental investigation employs a pre-and post-test control group design. The overall average N-Gain results in both classes indicate achievement and enhancing statistical literacy through differences in SLS on medium criteria (0.3 ≤ g ≤ 0.7). When conducting the Wilcoxon test, it indicates 0.000 is less than the significance threshold of 0.05, so there is a difference in the average of the two classes, which means that. The implementation of treffinger learning affects the statistical literacy of primary students. Hence, treffinger learning can enhance the statistical literacy of primary students.

Keywords : *treffinger learning; statistical literacy; primary student*

1. Introduction

Literacy in mathematics is a necessity for primary school students as a fundamental skill in the 21st century (Ginanjar & Widayanti, 2019; Kusumadewi et al., 2019). It is because literacy skills have been confirmed to guarantee students' cognitive development to a higher cognitive level and become the knowledge capital of primary school students to succeed at the next level of education (Soodla et al., 2017; Suggate et al., 2018). The Education and Culture Ministry of the Republic of Indonesia, to prepare human resources to face the 21st century, has launched a literacy movement program in primary school education (Abidin et al., 2020; Kemendikbud, 2021). In this century, the skills needed by primary students are not only reading, writing, and arithmetic. Instead, it is a skill that emphasizes understanding problems, communicating, and interpreting data presented as numerics, graphs, and thinking critically about the data read in mathematics (Bandur et al., 2022; Priyambodo & Maryati, 2019; Setiani & Suyitno, 2021). This skill is called statistical literacy (Kathy et al., 2022; Tiro, 2018).

Statistical literacy is not much different from other literacy. If reading literacy focuses on the use of words, then statistical literacy emphasizes aspects of decision-making through statistical methods (Budgett & Pfannkuch, 2010). Statistical literacy permits the extraction of qualitative data from quantitative data and generation of new information from both qualitative and quantitative data. Statistical literacy also does not only rely on reading and evaluating data but requires an emphasis on students' cognitive skills, contextual understanding, and critical thinking (Jenny et al., 2018; Sharma, 2017). Statistical literacy includes basic skills, namely organizing data, creating tables, and completing different data representations, so it is important to use it in understanding information (Callingham & Watson, 2017; Gal, 2019).

Statistical literacy requires primary students to understand and interpret the concepts they have learned. In this case, students must know the purpose of statistical concepts rather than just solving statistical problems (Gould, 2017; Masfingatin & Suprapto, 2020). Statistical literacy is very important for primary students in determining a conclusion based on statistical data analysis (Fadillah & Munandar, 2021; Gebre, 2018; Priyambodo & Maryati, 2019; Rohayati et al., 2020). Thus, statistical literacy can be understood as a reading, writing, comprehending, analyzing (basic level), and interpreting data utilizing fundamental skills, presenting data in tables, graphs, and statistical notation.

There is a research gap based on the findings of previous studies, namely between the statistical literacy of primary students, which is still inadequate and the need for statistical literacy for primary students. The achievement of stable PISA scores yearly raises the suspicion that statistical literacy at the primary school level is still underdeveloped (Comings, 2017; Junika et al., 2020). In Indonesia, mathematics textbooks and curricula contain several materials that support statistical literacy (Senk & Thompson, 2020; Setiawan, 2021). In the results of other studies, students experience the inaccuracy of data analysis as part of statistical literacy 80%. It is because primary students do not understand the basic concepts of statistics (Kusumaningpuri et al., 2022; Tractenberg, 2017). Meanwhile, in the educational practice of primary schools, statistical literacy has not become the focus of national literacy (Setiawan, 2019). This low statistical literacy can be seen when reading, processing, and presenting data is still in the low category (Amalia et al., 2020; English, 2018). In addition, primary students often think that statistics is a difficult subject to learn, thus making them dislike mathematics (Auliya, 2019; Hedges & Harkness, 2017). Whereas primary students can need statistical literacy to guarantee the cognitive level of higher-order thinking, for example, creative thinking, critical thinking, and metacognitive (Ginanjar & Widayanti, 2019; Soodla et al., 2017).

Meanwhile, a preliminary study at Tambak Rejo II State Primary School found that primary students had low statistical literacy, namely 82% (33 of 40 students) had a low understanding of basic statistical concepts. In this case, students fail to read the data, determine the ratio of values to the data and explore information on the data. It was also found that the teacher did not facilitate students in learning that were oriented towards interpreting statistical data in a constructivist manner and trained students in critically evaluating statistical data.

Difficulties students' in understanding statistical data can be overcome by designing or choosing the right lesson (Huang et al., 2019; Kusumaningpuri et al., 2022). In this case, the teacher must provide opportunities for students to develop statistical understanding and encourage them to build their own mathematical knowledge through problem-solving in everyday life (Fadillah & Munandar, 2021; Maryati, 2021). The role of student activity interaction through problem-solving will affect student learning success (Aisyah et al., 2021; Tan, 2015). In addition, teachers can increase the intensity of providing training on statistical literacy questions related to everyday life (Núñez Castellar et al., 2015).

Treffinger learning provides opportunities for students to understand problem-solving concepts, develop thinking skills and interpret problems, collect data, analyze, generate ideas, and try to solve problems (Andriatna et al., 2021). Treffinger learning has characteristics, namely involving: students actively in problem-solving, combining cognitive and affective aspects to find solutions in solving given problems, students conducting joint investigations with groups to strengthen their ideas, and students are able to apply their newfound knowledge to other everyday problems (Putu et al., 2019; Verschaffel et al., 2020).

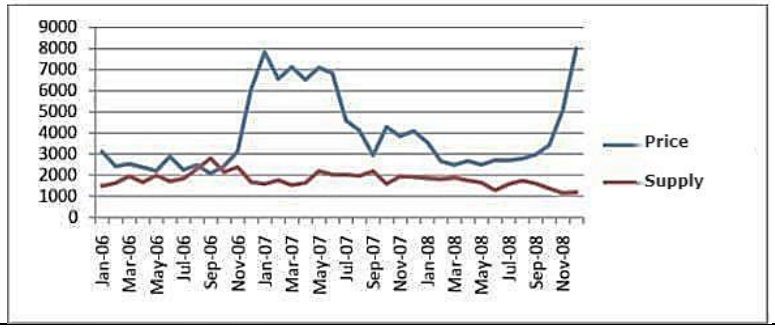
Thus, there is a problem of statistical literacy for primary students, which is still inadequate based on the previous studies. Meanwhile, the preliminary studies results at Tambak Rejo II State Primary School found that statistical literacy is urgently needed for primary students to interpret, evaluate critically, and communicate statistical messages in solving problems. Meanwhile, based on the treffinger learning study. Treffinger learning has the characteristics to be able to improve the statistical literacy characteristics of primary students. The questioned characteristic is the success of primary student learning activities. In order for students to interpret, evaluate critically, and communicate statistical problem-solving messages (Callingham & Watson, 2017; Kusumaningpuri et al., 2022). In addition, the implementation of treffinger learning so far has not focused on enhancing statistical literacy (Aisyah et al., 2021; Indrawati, 2019; Maulana, 2019; Ndiung, 2020; Setianingsih & Waluya, 2019). Thus, to bridge the research gap regarding the problem of low statistical literacy and the need for statistical literacy for primary students, there is an urgency for research to implement treffinger learning in order to influence and enhance statistical literacy in primary students. This study aims to investigate the effect of treffinger learning on the academic performance and statistical literacy of primary school students.

2. Method

This type of quantitative study employs an experimental method and a pretest-posttest control group design. Before and after learning, the statistical literacy of primary school students in the experimental and control groups was measured. During this time, the research participants included 40 students of class VI primary schools at Tambak Rejo II State Primary School (one of the schools in the Sidoarjo area, East Java).

Data was collected by giving a statistical literacy test (SLT). In this study, SLT is a research instrument. The SLT consists of three assignment items in the form of essay questions, see Table 1. The SLT is based on statistical literacy indicators about reading data, finding the ratio between data values, and extracting information (Aoyama & Stephens, 2003). Meanwhile, the results of the SLT were evaluated using the criteria for scoring guidelines in terms of being unable, moderately able, and capable (Oktaviyanthi & Agus, 2019), see Table 2.

Table 1. SLT Instrument

<table>
<tr><th>Item</th><th>Question</th></tr>
<tr><td>1</td><td>Pay attention to the information presented in the following table.
The following table shows the scores for the Math exam results.
<table>
<tr><th>Exam to-</th><th>Score</th><th>Exam to-</th><th>Score</th></tr>
<tr><td>1</td><td>7</td><td>6</td><td>8</td></tr>
<tr><td>2</td><td>6</td><td>7</td><td>6</td></tr>
<tr><td>3</td><td>4</td><td>8</td><td>5</td></tr>
<tr><td>4</td><td>8</td><td>9</td><td>8</td></tr>
<tr><td>5</td><td>9</td><td>10</td><td>7</td></tr>
</table>
Based on the table above, choose more than one answer related to the appropriate statement below.
 The 10th Math test score is 7.
 The 4th and 8th repetitions have the same scores.
 The 4th, 6th, and 9th tests have the same scores.
 The 7th Math test score is 8.</td></tr>
<tr><td>2</td><td>Pay attention to the results of collecting data on the number of marbles from 40 children.
25 23 28 28 29 24 26 22 22 25
30 27 24 28 25 22 28 27 27 24
28 23 28 22 28 26 26 25 28 24
30 29 25 23 29 26 27 28 29 30
Select more than one answer corresponding to the following statements based on these data.
 The number of children who have 24 marbles is the same as the number of children who have 26 marbles.
 The mode of the data on the number of marbles is 28.
 The median of the data is 26.5
 The lowest number of marbles owned by the child is 23 marbles.</td></tr>
<tr><td>3</td><td> 
</td></tr>
</table>

Choose the statement that best corresponds to the information displayed in the graph.

- Tomatoes are more expensive during the summer and less expensive during the winter.
- When the weather is warm, the supply of tomatoes increases, while when it is cold, it decreases.
- As more people purchase tomatoes when they are abundant, the price of tomatoes decreases.
- When the supply of tomatoes is low, prices are typically high, while they are typically low when the supply is high.

Table 2. Statistical literacy scoring indicators and criteria

Indicator → Descriptor	Scoring Criteria	Score
Reading Data → Knowing the information from the data presented is by determining certain values in the data	Unable to understand data.	0
	Able to understand the data, but there are still errors.	1
	Able to understand information or data accurately.	2
Finding the Ratio Between Scores→ Reads the maximum and minimum values in a graph and can determine the ratio between multiple scores in the data.	Unable to understand the ratio between data values.	0
	Able to understand the ratio between data values, but there are still errors.	1
	Able to understand the ratio between data values accurately.	2
Digging information → Exploring qualitative information from the quantitative information provided by the data.	Unable to dig up information.	0
	Able to dig up information, but there are still errors	1
	Able to understand information or data accurately.	2

This investigation lasted three months, from December 2021 to February 2022. Research procedures were carried out by dividing 40 students by random sampling into experimental groups and control groups. The experimental group is a class that follows mathematics learning using treffinger learning, while the control group is a class that uses conventional learning. In this study, 20 students were assigned to the experimental class is VI A, while the control class is VI B. Both classes were conducted 1 lesson every week regarding the interpretation and analysis of statistical data. At the beginning and end of the meeting, students in both classes were given the SLT to determine their statistical literacy level.

The primary students' statistical literacy test results data were analyzed in four stages: First, calculating the pretest and posttest scores for both classes using descriptive statistics. Second, calculating achievement and enhancing the statistical literacy score (SLS) category in terms of low, medium, and high using the normalized gain formula (Meltzer, 2002), which is then confirmed by using the N-Gain category (Hake, 1998). Specifically with regard to enhancing high in $g > 0.7$, medium in $0.3 \leq g \leq 0.7$, and low in $g < 0.3$. Third, test for normality of variance using the Shapiro Wilk test. Fourth, Wilcoxon tests the research results' hypothesis to determine the significance of treffinger learning on primary students' statistical literacy.

3. Results and Discussion

Results

The results obtained at the Tambak Rejo II State Primary School for students class VI A is the experimental group, while Class VI B is the control group indicate that the implementation

of treffinger learning has an effect and improves primary students' statistical literacy. The results of calculating the descriptive statistical values for the two SLS classes are presented in Table 3.

Table 3. SLS descriptive statistics in the classes of experiments and controls

SLS	N	Range	Min.	Max.	Mean	SD
Experiment-Pretest	20	40	30	70	48.25	11.729
Experiment-Posttest	20	50	50	100	76.50	16.944
Control-Pretest	20	40	30	70	44.00	9.947
Control-Posttest	20	50	50	100	69.50	13.945
Valid N (listwise)	20					

The average value of statistical literacy in Table 3 shows the difference before and after learning. This can be seen from the experimental class's descriptive statistical value, which has a minimum pretest value of 30 and a minimum posttest value of 50. Meanwhile, the experimental class's minimum and maximum posttest values are 70 and 100. Meanwhile, the average values before and after are given treatment In the experimental class, there was a discernible distinction. The average pre-test score for the control group is 44, while the average post-test score is 69.50. Prior to implementation, the average pre-test score in the experimental class was 48.25, while the average post-test score was 76.50. This represents the difference between the average results of the experimental and control groups on a test of statistical literacy.

Table 4. SLS categories in the classes of experiments and controls

SLS Category	Experiment			Control		
	Pre	Post	Gain (g)	Pre	Post	Gain (g)
High	53.57	93.75	0.88	49	87	0.77
Medium	45	72.5	0.49	43.33	70.56	0.48
Low	43.33	57.5	0.24	40.83	53.33	0.21
Whole	47.3	74.58	0.54	44.39	70.3	0.48

Table 4 illustrates the enhancement of SLS primary students between the experimental and control groups. Through the difference in SLS on medium criteria ($0.3 \leq g \leq 0.7$), the overall N-Gain average results for both classes indicate an enhancement in statistical literacy (Hake, 1998). The value of the experimental class is 0.54, while the value of the control class is 0.48. In this instance, the N-gain value for the high SLS category in the experimental group is 0.88, whereas it is 0.77 in the control group. In the medium SLS category, the experimental class received 0.49 while the control class received 0.48. The experimental class received 0.24 in the low category, while the control class received 0.21.

Table 5. Normality test results on achievement and enhancing statistical literacy

	Shapiro Wilk		
Statistical literacy	Statistik	df	Sig.
Achievement	0.926	40	0.012
Enhancing	0.924	40	0.010

Table 5 shows the normality test results using the Shapiro Wilk test through SPSS version 25. Measuring achievement and enhancing statistical literacy of primary students is done by setting =0.05. The achievement value of students' statistical literacy learning outcomes is sig. 0.012. Meanwhile, enhancing statistical literacy is significatively 0.10. It indicates that The research data do not follow a normal distribution. Because the obtained

significance value is less than 0.05. Therefore, the data were analyzed using data interpretation in each SLS category according to Figure 1 and Figure 2.

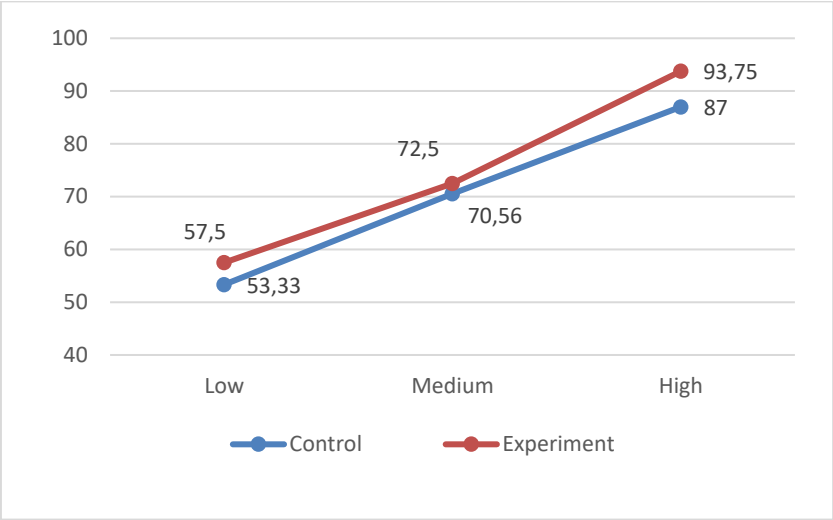


Figure 1. SLS achievement interactions based on category

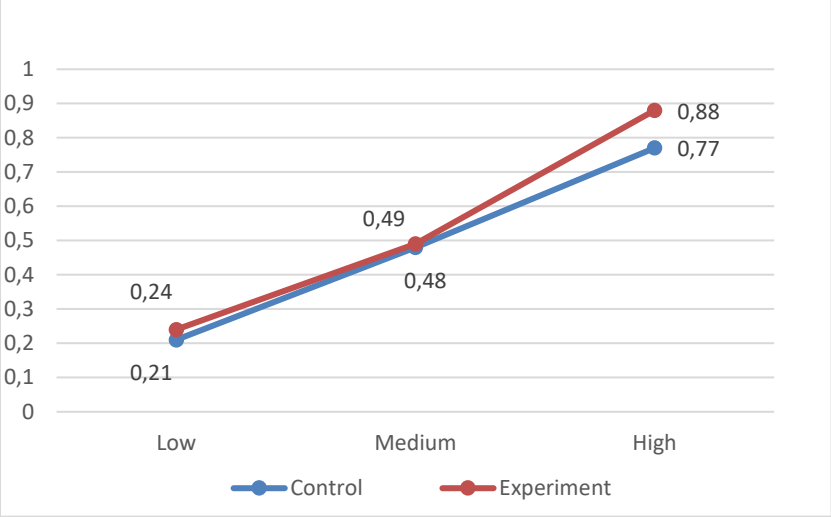


Figure 2. SLS enhancing interactions based on category

All SLS categories (high, medium, and low) in the experimental class in Figure 1 and Figure 2 have higher achievement and enhanced statistical literacy than students in the control class. In this case, both the experimental and control groups experienced SLS improvement. However, when the posttest scores of the two groups were compared, there was no significant difference. The experimental group was found to have a higher SLS than the experimental class. These results indicate that treffinger learning is more effective in enhancing the statistical literacy of primary students.

Table 6. Wilcoxon test results pertaining to the influence of treffinger on statistical literacy

SLS	Posttest-Pretest Experiment	Posttest-Pretest Control
Z	-3.927[b]	-3.929[b]
Asymp. Sig. (2-tailed)	.000	.000

In Table 6, the Wilcoxon test results for the SLT reveal that the probability value of 0.000 is below the significance threshold of 0.05. If the value of Sig. (2-tailed) is less than 0.05, a decision is made. Consequently, there is a difference between the two classes' means. It suggests that the implementation of treffinger learning has an impact on the statistical literacy of elementary students.

Discussion

The results reveal statistically significant differences in the performance of primary school students in experimental and control classes in all high, medium, and low categories. This result is consistent with previous studies' findings on the relationship between learning and motivation oriented toward enhancing statistical literacy in different classes. A comparison will also increase students' statistical literacy scores according to their respective levels. The mathematical ability of the experimental class has an increase in statistical literacy higher than the control group at all levels (Alhaddad, 2015; Takaria & Rumahlatu, 2016; Takaria & Talakua, 2018). Another study found statistical literacy skills to be 16% higher in the high category, 60% higher in the medium category, and 24% lower in the low category (Fadillah & Munandar, 2021). The overall average value of N-Gain is 0.62, which means that the increase in statistical learning outcomes occurs in the medium category. Another study showed that 40% of students experienced an additional 56% in the high category and 4% in the low category (Wahab et al., 2021). The results of other studies are similar: statistical literacy is 13 students in the highest, 46 students in the medium, and 8 students in the lowest (Maryati, 2021). The studies' results are somewhat different, namely that students who have high, medium, and low levels of statistical literacy still cannot achieve the ideal statistical literacy indicators simultaneously (Ratnawati et al., 2020). Students with a high statistical literacy category can complete indicators 1 to 3 at levels 5-6. Students with moderate ability meet indicator 1 but do not meet indicators 2 and 3 at levels 3-5. While the low category meets indicator 1 but does not meet indicators 2 and 3 at levels 1-3 (Risqi & Rini Setianingsih, 2021)

Another finding in this study shows a higher achievement of statistical literacy for primary students in the experimental class. The Shapiro Wilk normality test on achievement resulted in a sig value. 0.012 and 0.05 indicate that the data do not follow a normal distribution. In this instance, the experimental and control groups achieved differently based on their posttest scores. Specifically, the experimental group outperformed the control group. This study's findings are similar to those of previous research in that the experimental group performed better on posttests than the control group (Takaria & Rumahlatu, 2016; Takaria & Talakua, 2018). On the other hand, in the posttest, 52% of students fall within the medium category, while 40% fall within the high category (Wahab et al., 2018). The low achievement of statistical literacy in the control class can be caused by not optimal learning during the Covid-19 pandemic. Low achievement statistical literacy usually occurs in understanding concepts and errors occur in solving problems (Fadillah & Munandar, 2021). The results of other studies report low achievement on each indicator. In interpreting the data, the greatest proportion is 57.78% and the indicator provides information with the lowest percentage, which is 35.56% (Irwandi et al., 2022).

The next finding is regarding the interaction of treffinger learning influence that affects statistical literacy primary students by using the Wilcoxon test. There is a difference between the two classes' averages. The findings of previous research indicate that this interaction is caused by treffinger learning which has a problem-solving orientation. Treffinger's creative learning with the realistic mathematics education (RME) principle produces higher creative thinking skills than students who learn using conventional learning. The acquisition value of F = 17,195 with sig 0.001 has shown this (Ndiung, 2019). Other studies also have The influence

of problem-focused treffinger learning on achievement and improvement in mathematical communication (Alhaddad, 2015). Previous research resulted in the effect of the Treffinger teaching model with an approach to solving open-ended problems to enhance students' creative thinking, which was seen in the average pretest score of 62.29 and posttest of 80.06 (Triwibowo et al., 2017). Another study resulted in sig=0.721, which means that the significance level exceeds 0.05, or that the hypothesis is accepted. It indicates a relationship between treffinger learning and mathematical resilience (Rohmah et al., 2020). Students using treffinger learning assisted by problem cards have a higher creative thinking level than students using the PBL model (Dwijanto et al., 2019). Statistical literacy through collaborative problem solving resulted in a higher increase than the expository group. This happens because of the effective use of collaborative problem-solving models (Takaria & Talakua, 2018). Another study states that students who have good statistical literacy can be facilitated by collaborative problem-solving models, because students' abilities can be explored through discussion of opinions between students (Takaria et al., 2020).

The findings of this study resulted in improving and achieving statistical literacy for primary students in grades 1, 2, and 3 through the application of treffinger learning. This result is similar to the previous study, but previous studies have focused on high-grade primary schools, such as fourth grade. Nor do these studies focus on the application of trefinger learning, not on statistical material and not on improving statistical literacy through trefinger learning. Treffinger learning improves and achieves statistical literacy for primary students in high grade (Alhaddad, 2015). Another study resulted in an increase in statistical literacy in primary students with higher N-Gain (medium category) compared to expository learning (low category) through problem-solving learning (Takaria & Rumahlatu, 2016). Another study showed the effect of treffinger learning by increasing flat-level learning outcomes for grade four primary students with N-Gain results of 73.3% in the high tier, 20% in the medium tier, and 6.5% in the low tier (Ali et al., 2021). The class subjected to the implementation of treffinger learning had higher statistical literacy enhancing senior high school students than the class given conventional learning. This is obtained from the difference between the average N-Gain of the two classes showing sig. 0.024 and sig. 0.012. With decision making if sig. (1-tailed) < 0.05, then H0 is rejected (Nizham et al., 2017). Relatively different research results occurred in the increase in primary students' statistical learning outcomes after the implementation of statistics learning. This study showed that 40% of students experienced a rise 56% in the medium category, and 4% in the low category. (Wahab et al., 2021). After implementing the statistical module, there was a significant increase and difference in students' statistical literacy gain value, namely at the pretest of 10.96 and the posttest of 22.68 (Wahab et al., 2018).

Thus, treffinger learning provides opportunities for students to understand problem-solving concepts, develop thinking skills and interpret problems, collect data, analyze, generate ideas, and try to solve problems (Andriatna et al., 2021). Treffinger learning has characteristics, namely involving: students actively in problem-solving, combining cognitive and affective aspects to find solutions in solving given problems, students conducting joint investigations with groups to strengthen their ideas, and students are able to apply their newfound knowledge to other everyday problems (Collesi, 2019; Putu et al., 2019; Verschaffel et al., 2020). In this case, treffinger learning affects the enhancement and achievement of statistical literacy for primary students, because treffinger learning has critical stages of understanding and analyzing statistical problems. Treffinger learning has several stages that make it easier for primary students to solve problems. Namely: the first stage is basic tools; students can explore various possible solutions that allow them to develop a creative idea without fear of being rejected based on their experience and knowledge. The second stage involves process practice; students are given complex problems to solve that cause cognitive conflicts to take advantage of their potential to solve problems. The third stage is working with the real problem, involving students' thinking in real challenges and encouraging students to find solutions to the problems given (Main et al., 2019; Sophonhiranrak et al., 2015; Van Hooijdonk et al., 2020; Zainal & Halik, 2019). As one of the characteristics of treffinger learning, students are given the freedom to comprehend and solve problems. The freedom to

comprehend and solve problems is the defining characteristic of treffinger learning (Maulana, 2019; Mawardino & Fauzan, 2019; Ridwan et al., 2019; Rohmah et al., 2020).

Based on the results and discussion presented in the preceding section, it is possible to conclude that the implementation of treffinger learning can achieve and improve the statistical literacy of primary students. The data analysis test results indicate that there was a difference between the implementation of treffinger learning prior to and after receiving treatment in the experimental class. Primary students are also experience-enhancing in statistical literacy. Therefore, treffinger learning can be used as a solution to stimulate and encourage enhancing the statistical literacy of primary students.

4. Conclusion

Learning treffinger has a consequence on the enhancement of primary students' statistical literacy. So that the impact significance of treffinger learning on enhancing statistical literacy can be further tested, it is recommended for future research to use a larger sample or population. In addition, it is suggested that research on the implementation of treffinger learning is not only in high-grade grades in primary schools, as is the case in this study but also in lower grades, for example, grades 1,2,3 primary schools. It is possible because primary students in low grades also have initial knowledge and skills in interpreting and elaborating statistical data as part of their statistical literacy skills.

5. References

Abidin, Z., Utomo, A. C., Pratiwi, V., & Farokhah, L. (2020). Project based learning - literacy in improving students' mathematical reasoning abilities in elementary schools. *JMIE (Journal of Madrasah Ibtidaiyah Education)*, *4*(1), 39. https://doi.org/10.32934/jmie.v4i1.170

Aisyah, S., Riyanto, Y., & Suhanadji, S. (2021). Pengaruh model pembelajaran treffinger terhadap kemampuan berpikir kritis dan hasil belajar siswa. *Jurnal Riset Dan Inovasi Pembelajaran*, *1*(1), 1–10. https://doi.org/10.51574/jrip.v1i1.7

Alhaddad, I. (2015). Enhancing students' communication skills through treffinger teaching model. *Journal on Mathematics Education*, *6*(1), 31–39. https://doi.org/10.22342/jme.6.1.1856.31-39

Ali, N. annisa, Takaria, J., & Pattimukay, N. (2021). Pengaruh model pembelajaran treffinger terhadap hasil belajar siswa pada materi bangun datar kelas IV MI Salman Al Farisi Liang. *Pedagogika : Jurnal Pedagogik Dan Dinamika Pendidikan*, *9*(1), 27–34. https://doi.org/https://doi.org/10.30598/pedagogikavol9issue1year2021

Amalia, F., Wildani, J., &, & Rifa'i, M. (2020). Literasi statistik siswa berdasarkan gaya kognitif field dependent dan field independent. *Jurnal Edukasi Matematika Dan Sains*, *8*(1), 1. https://doi.org/10.25273/jems.v8i1.5626

Andriatna, R., Kurniawati, I., & Wulandari, A. N. (2021). Profil kemampuan literasi statistik mahasiswa calon guru matematika. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *7*(1), 19–28. https://doi.org/10.24853/fbc.7.1.19-28

Aoyama, K., & Stephens, M. (2003). Graph interpretation aspects of statistical literacy: A japanese perspective. *Mathematics Education Research Journal*, *15*(3), 207–225. https://doi.org/10.1007/BF03217380

Auliya, R. N. (2019). Can mathematics and statistics perception explain students' statistical literacy? *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *3*(2), 86. https://doi.org/10.23917/jramathedu.v3i2.5983

Bandur, A., Hamsal, M., & Furinto, A. (2022). 21st Century experiences in the development of school-based management policy and practices in Indonesia. *Educational Research for Policy and Practice*, *21*(1), 85–107. https://doi.org/10.1007/s10671-021-09293-x

Budgett, S., & Pfannkuch, M. (2010). Assessing students' statistical literacy. *Assessment Methods in Statistical Education: An International Perspective*, 103–121. https://doi.org/10.1002/9780470710470.ch9

Callingham, R., & Watson, J. M. (2017). The development of statistical literacy at school. *Statistics Education Research Journal*, *16*(1), 181–201. https://doi.org/10.52041/serj.v16i1.223

Collesi, P. (2019). Statistical literacy: A key to comprehend a changing world. *AStA Wirtschafts- Und Sozialstatistisches Archiv*, *13*(3–4), 203–211. https://doi.org/10.1007/s11943-019-00248-6

Comings, J. P. (2017). The next step for literacy. *Prospects*, *47*(3), 167–174. https://doi.org/10.1007/s11125-018-9434-0

Dwijanto, Tayani, M., & Veronica, R. B. (2019). The mathematical creative thinking ability viewed from learning interest in eleventh grade of vocational high school by using treffinger model assisted by problem card. *Unnes Journal of Mathematics Education*, *8*(1), 26–33. https://doi.org/10.15294/ujme.v8i1.29349

English, L. D. (2018). *Young children's statistical literacy in modelling with data and chance*. 295–313. https://doi.org/10.1007/978-981-13-1044-7_17

Fadillah, F., & Munandar, D. R. (2021). *Analisis kemampuan literasi statistis dalam pembelajaran matematika di masa pandemi*. *4*(5), 1157–1168. https://doi.org/10.22460/jpmi.v4i5.1157-1168

Gal, I. (2019). *Understanding statistical literacy : About knowledge of contexts and models*. http://hdl.handle.net/10481/55029

Gebre, E. H. (2018). Young adults' understanding and use of data: Insights for fostering secondary school students' data literacy. *Canadian Journal of Science, Mathematics and Technology Education*, *18*(4), 330–341. https://doi.org/10.1007/s42330-018-0034-z

Ginanjar, A. Y., & Widayanti, W. (2019). Penerapan model pembelajaran multiliterasi untuk meningkatkan kemampuan literasi matematis siswa di SD/MI. *Primary : Jurnal Keilmuan Dan Kependidikan Dasar*, *10*(2), 117. https://doi.org/10.32678/primary.v10i02.1283

Gould, R. (2017). Data literacy is statistical literacy. *Statistics Education Research Journal*, *16*(1), 22–25. https://doi.org/10.52041/serj.v16i1.209

Hake, R. R. (1998). Interactive-engagement versus traditional methods. *American Journal of Physics*, *66*, 64–74. https://doi.org/https://doi.org/10.1119/1.18809

Hedges, S., & Harkness, S. S. (2017). Is gaise evident? College students' perceptions of statistics classes as "almost not math"1. *Statistics Education Research Journal*, *16*(1), 337–356. https://doi.org/10.52041/serj.v16i1.234

Huang, T. C., Lin, W., & Yueh, H. P. (2019). How to cultivate an environmentally responsible maker? A CPS approach to a comprehensive maker education model. *International Journal of Science and Mathematics Education*, *17*, 49–64. https://doi.org/10.1007/s10763-019-09959-2

Indrawati, F. (2019). Analisis model pembelajaran treffinger terhadap kemampuan komunikasi matematika. *Panel Nasional Pendidikan Matematika*, *0812*(80), 339–350. http://proceeding.unindra.ac.id/index.php/DPNPMunindra/article/view/598

Irwandi, B., Roza, Y., & Maimunah, M. (2022). Analisis kemampuan literasi statistis peserta Asesmen Kompetensi Minimum (AKM). *Jurnal Gantang*, *6*(2), 177–183. https://doi.org/10.31629/jg.v6i2.3961

Junika, N., Izzati, N., & Tambunan, L. R. (2020). Pengembangan soal statistika model PISA untuk melatih kemampuan literasi statistika siswa. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(3), 499–510. https://doi.org/10.31980/mosharafa.v9i3.615

Kathy, S., Pam, S., Edward, M., Iram, S., & Taggart, B. (2022). *Developing 21st century skills in early childhood: The contribution of process quality to self-regulation and pro-social behaviour*. *310*. https://doi.org/10.1007/s11618-020-00945-x

Kemendikbud. (2021). *Gerakan literasi sekolah (GLS)*. https://www.quipper.com/id/blog/info-guru/gerakan-literasi-sekolah/

Kusumadewi, R. F., Ulia, N., & Ristanti, N. (2019). Efektivitas model pembelajaran discovery learning terhadap kemampuan literasi matematika di sekolah dasar. *Sekolah Dasar: Kajian Teori Dan Praktik Pendidikan*, *28*(1), 11–16. https://doi.org/10.17977/um009v28i12019p011

Kusumaningpuri, A. R., Murtiyasa, B., Fuadi, D., & Hidayati, Y. M. (2022). Analisis kesulitan

matematika pokok bahasan statistika pada siswa sekolah dasar. *Jurnal Basicedu*, *6*(2), 933–942. https://doi.org/10.31004/basicedu.v6i1.2058

Main, L. F., Delcourt, M. A. B., & Treffinger, D. J. (2019). Effects of group training in problem solving style on future problem solving performance. *Journal of Creative Behavior*, *53*(3), 274–285. https://doi.org/10.1002/jocb.176

Maryati, I. (2021). Analisis kemampuan literasi statistis dalam materi variabilitas. *RANGE: Jurnal Pendidikan Matematika*, *3*(1), 56–67. https://doi.org/10.32938/jpm.v3i1.1149

Masfingatin, T., & Suprapto, E. (2020). Student's statistical literacy skills based on the reflective and impulsive cognitive styles. *Al-Jabar : Jurnal Pendidikan Matematika*, *11*(2), 273–286. https://doi.org/10.24042/ajpm.v11i2.6902

Maulana, D. F. (2019). The ability of mathematical literacy on learning treffinger realistic assistance schoology. *Journal of Physics: Conference Series*, *1321*(3). https://doi.org/10.1088/1742-6596/1321/3/032132

Mawardino, M., & Fauzan, A. (2019). *The influence of treffinger model on creative thinking ability in terms of cognitive style*. *178*(ICoIE 2018), 505–507. https://doi.org/10.2991/icoie-18.2019.108

Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gains in physics: A possible "hidden variable" in diagnostic pretest scores. *American Journal of Physics*, *70*(12), 1259–1268. https://doi.org/10.1119/1.1514215

Ndiung, S. (2019). Treffinger creative learning model with RME principles on creative thinking skill by considering numerical ability. *International Journal of Instruction*, *12*(3), 731–744. https://doi.org/10.29333/iji.2019.12344a

Ndiung, S. (2020). Efektivitas model pembelajaran treffinger dalam menumbuhkan keterampilan berpikir kreatif peserta didik sekolah dasar. *Prisma*, *9*(2), 167. https://doi.org/10.35194/jp.v9i2.1042

Nizham, H., Suhendra, S., & P., B. A. (2017). Improving ability mathematic literacy, self-efficacy and reducing mathematical anxiety with learning Treffinger model at senior high school students. *International Journal of Science and Applied Science: Conference Series*, *2*(1), 130. https://doi.org/10.20961/ijsascs.v2i1.16696

Núñez Castellar, E., All, A., De Marez, L., & Van Looy, J. (2015). Cognitive abilities, digital games and arithmetic performance enhancement: A study comparing the effects of a math game and paper exercises. *Computers and Education*, *85*, 123–133. https://doi.org/10.1016/j.compedu.2014.12.021

Oktaviyanthi, R., & Agus, R. N. (2019). Eksplorasi kemampuan pemecahan masalah berdasarkan kategori proses literasi matematis. *Jurnal Pendidikan Matematika*, *13*(2), 163–184. https://doi.org/10.22342/jpm.13.2.7066.163-184

Priyambodo, S., & Maryati, I. (2019). Peningkatan kemampuan literasi statistis melalui model pembelajaran berbasis proyek yang dimodifikasi. *Mosharafa: Jurnal Pendidikan Matematika*, *8*(2), 273–284. https://doi.org/10.31980/mosharafa.v8i2.496

Putu, N., Ayuningsih, M., & Dwijayani, N. M. (2019). Pengaruh model treffinger berorientasi kearifan lokal berbantuan tugas berjenjang terhadap self efficacy matematika siswa SMP. *Jurnal Matematika Kreatif -Inovatif*, *10*(1), 105–111.

Ridwan, R., Supriyadi, E., & Nurmanita, M. (2019). *The effect of treffinger learning model on critical thinking ability of students in SMK 3 Yogyakarta*. *326*(Iccie 2018), 445–451. https://doi.org/10.2991/iccie-18.2019.78

Risqi, E. N., & Rini Setianingsih. (2021). Statistical literacy of secondary school students in solving contextual problems taking into account the initial statistical ability. *Mathematics Education Journal*, *4*(1), 43–54. https://doi.org/10.21067/pmej.v4i1.5285

Rohayati, S., Agustini, A., & Abdullah, A. A. (2020). Teaching an undergraduate statistics class in digital era. *Proceeding International Conference on Science and Engineering*, *3*(April), 371–373. https://doi.org/10.14421/icse.v3.530

Rohmah, S., Kusmayadi, T. A., & Fitriana, L. (2020). The effect of the treffinger learning model on mathematical connection ability students viewed from mathematical resilience. *International Journal of Multicultural and Multireligious Understanding*, *7*(5), 275–284. https://doi.org/10.18415/ijmmu.v7i5.1621

Senk, S. L., & Thompson, D. R. (2020). School mathematics curricula. In *Standards-Based School Mathematics Curricula*. Springer Singapore. https://doi.org/10.4324/9781003064275-1

Setiani, N. W., & Suyitno, A. (2021). Kemampuan membaca data dan rasa ingin tahu siswa terhadap kemampuan literasi statistik. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *13*(2), 257–270. https://doi.org/10.37680/qalamuna.v13i2.915

Setianingsih, Y. I., & Waluya, S. B. (2019). Creative mathematical thinking ability viewed from the student learning styles in treffinger model. *Journal of Primary Education*, *8*(6), 269–275.

Setiawan, E. P. (2019). Analisis muatan literasi statistika dalam buku teks matematika Kurikulum 2013. *Pythagoras: Jurnal Pendidikan Matematika*, *14*(2), 163–177. https://doi.org/10.21831/pg.v14i2.28558

Setiawan, E. P. (2021). Literasi statistika dalam kurikulum matematika Sekolah Dasar (SD) 2004-2020 : Tinjauan historis dan pengembangannya statistical literacy in indonesian primary school mathematics curricula 2004-2020. *Historical Review and Development*, *6*, 2004–2020. https://doi.org/10.24832/jpnk.v6i1.1915

Soodla, P., Jõgi, A. L., & Kikas, E. (2017). Relationships between teachers' metacognitive knowledge and students' metacognitive knowledge and reading achievement. *European Journal of Psychology of Education*, *32*(2), 201–218. https://doi.org/10.1007/s10212-016-0293-x

Sophonhiranrak, S., Suwannatthachote, P., & Ngudgratoke, S. (2015). Factors affecting creative problem solving in the blended learning environment: A review of the literature. *Procedia - Social and Behavioral Sciences*, *174*(1982), 2130–2136. https://doi.org/10.1016/j.sbspro.2015.02.012

Suggate, S., Schaughency, E., McAnally, H., & Reese, E. (2018). From infancy to adolescence: The longitudinal links between vocabulary, early literacy skills, oral narrative, and reading comprehension. *Cognitive Development*, *47*(April), 82–95. https://doi.org/10.1016/j.cogdev.2018.04.005

Takaria, J., & Rumahlatu, D. (2016). The effectiveness of CPS-ALM model in enhancing statistical literacy ability and self concept of elementary school student teacher. *Journal of Education and Practice*, *7*(25), 44–49. https://eric.ed.gov/?id=EJ1115857

Takaria, J., & Talakua, M. (2018). The ability of statistical literacy student teacher candidate in terms of prior-ability on mathematics. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *2*(2), 395–408. https://doi.org/10.21831/jk.v2i2.18768

Takaria, J., Wahyudin, W., Sabandar, J., & Dahlan, J. A. (2020). Relationship between statistical literacy and mathematical representation of students through collaborative problem solving model. *Infinity Journal*, *9*(2), 183. https://doi.org/10.22460/infinity.v9i2.p183-196

Tan, O. S. (2015). Flourishing creativity: Education in an age of wonder. *Asia Pacific Education Review*, *16*(2), 161–166. https://doi.org/10.1007/s12564-015-9377-6

Tiro, M. A. (2018). National movement for statistical literacy in Indonesia: An idea. *Journal of Physics: Conference Series*, *1028*(1). https://doi.org/10.1088/1742-6596/1028/1/012216

Tractenberg, R. E. (2017). How the mastery rubric for statistical literacy can generate actionable evidence about statistical and quantitative learning outcomes. *Education Sciences*, *7*(1). https://doi.org/10.3390/educsci7010003

Triwibowo, Z., Dwidayati, N. K., & Sugiman. (2017). Analysis of mathematical creative thinking ability viewed from students learning styles in seventh grader through treffinger learning model with open-ended approach. *Unnes Journal of Mathematics Education*, *6*(3), 391–399. https://doi.org/10.15294/ujme.v6i3.17987

Van Hooijdonk, M., Mainhard, T., Kroesbergen, E. H., & van Tartwijk, J. (2020). Creative problem solving in primary education: Exploring the role of fact finding, problem finding, and solution finding across tasks. *Thinking Skills and Creativity*, *37*(August 2019), 100665. https://doi.org/10.1016/j.tsc.2020.100665

Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: A survey. *ZDM - Mathematics Education*, *52*(1), 1–16.

https://doi.org/10.1007/s11858-020-01130-4

Wahab, A., Junaedi, J., & Azhar, M. (2021). Efektivitas pembelajaran statistika pendidikan menggunakan uji peningkatan n-gain di PGMI. *Jurnal Basicedu*, *5*(2), 1039–1045. https://doi.org/10.31004/basicedu.v5i2.845

Wahab, A., Mahmud, A., & Tiro, M. A. (2018). The effectiveness of a learning module for statistical literacy. *New Educational Review*, *53*(3), 187–200. https://doi.org/10.15804/tner.2018.53.3.16

Zainal, Z., & Halik, A. (2019). Pengaruh model pembelajaran treffinger terhadap hasil belajar matematika siswa SD Negeri 37 Model Parepare. *JIKAP PGSD : Jurnal Ilmiah Ilmu Kependidikan*, *00*(3). https://doi.org/10.26858/jkp.v3i3.10221