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The Influence of the Student Facilitator and Explaining Type Cooperative Learning Model on Students' Mathematics Learning Outcomes

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ABSTRACT

Purpose of the study: to determine the influence of the Student Facilitator and Explaining type cooperative learning model on students' mathematics learning outcomes

Methodology: The sample in this study were students of class XI Computer network Engineering 1 as the experimental class and students of class XI Industrial Automation Engineering 1 as the control class. This type of research is a quasi-experiment with a non-equivalent control group design using purposive sampling techniques. The data collection instruments used in this study were pretest and posttest sheets. The data collection technique used in this study was the test technique. The data analysis techniques used were descriptive statistical analysis and inferential statistical analysis.

Main Findings: In this study, the pretest data of the two classes showed differences, therefore by using the N-gain mean difference test of the two classes, it was obtained that $|Z_{\text{count}}| > |Z_{table}|$ ($Z_{\text{count}} = -6.74$; $Z\text{table} = 1.96$), this means that H_0 is rejected and H_1 is accepted, so it can be concluded that there is an influence of the Student Facilitator and Explaining learning models on the mathematics learning outcomes of class XI students of YPPI Tualang Vocational High School.

Novelty/Originality of this study: This study presents new findings on the effectiveness of the Student Facilitator and Explaining cooperative learning model in deepening students' understanding of mathematical concepts, which has not been widely explored at certain levels of education and in specific mathematics learning contexts.

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1. INTRODUCTION

Mathematics is one of the fields of study that plays an important role in education, this can be seen from the time of school hours more than other subjects [1]-[3]. Mathematics is a compulsory subject that is always present at every level of education from elementary school to college [4],[5].

Basically, mathematics is used in various aspects of life, both in education, social, economic, and other sciences [6]. Mathematics is a basic science that is general in nature, plays a role in the development of technology, especially to improve human thought patterns [7]. Mathematics is used and played by some people for the advancement of the era in today's modern education era and depends on how the person realizes it. So to master and create innovations in technology in the future, a strong mastery of mathematics is needed from an early age.

Based on the observation results, the researcher also found that in the process of learning mathematics in schools, especially YPPI Tualang Private Vocational High School, not all students who obtain learning outcomes exceed or are at the Minimum Completion Criteria. This is because students still have difficulty in understanding mathematics learning, they tend to memorize formulas rather than training themselves to find out the origin of the formulas. And when observing the Field Experience Practice activities, the researcher found that there were students who felt insecure about presenting solutions to problems given by the math teacher, while the students were able to solve the problems in their respective books. This causes a lack of confidence in the abilities possessed by students to appear in front of the class. As well as the lack of student learning motivation in mathematics, because of the assumption that mathematics is a fairly difficult subject.

In the subject of mathematics for class XI of YPPI Tualang Private Vocational High School, the learning outcomes obtained by students are still low. This can be seen from the results of daily student tests, most of which do not reach the minimum completion criteria. So it can be concluded that the mathematics learning outcomes obtained by class XI students of YPPI Tualang Private Vocational High School are still low, this can be seen from each class only 5-8 people who are only above the minimum completion criteria, there are even some who complete only one person in one class.

To improve students' mathematics learning outcomes as described above, the researcher tried to apply a learning model that can help students to improve their learning outcomes in mathematics learning and increase students' self-confidence to explain the solutions to problems that have been worked on in each student's book, namely using the Student Facilitator and Explaining learning model. This method is an alternative to develop cognitive abilities, train cooperation, and train the ability to communicate mathematics that is in accordance with the characteristics of vocational high school students [8]-[10]. Using this learning model can increase enthusiasm, motivation, activity, and pleasure. That way it can encourage students to master the material [11]-[13]. So by using this learning model, it is expected that students can participate in becoming learning facilitators for their friends and can master the material being studied and be able to improve students' mathematics learning outcomes [14]-[16].

Analysis of the gap between this research and previous research conducted by Merina [17] Previous studies have focused on the application of cooperative learning models, especially through the student tutoring, facilitator, and explaining approaches in the context of developing metacognition to improve informatics students' learning achievement, especially in problem-solving skills. Meanwhile, the current study more specifically evaluates the effect of the Student Facilitator and Explaining learning model on students' mathematics learning outcomes. The gap in this research lies in the difference in focus and context: previous studies have examined more diverse cooperative learning models in informatics courses and aspects of metacognition, while the current study focuses specifically on one cooperative model to see its impact on students' mathematics learning outcomes. This gap indicates the need for a more specific study of the effectiveness of certain models in mathematics, so that the results can provide more focused recommendations for improving learning outcomes in the subject.

The novelty of the study lies in its specific focus in examining the influence of the Student Facilitator and Explaining cooperative learning model on mathematics learning outcomes. Although cooperative learning models have been widely studied, this study offers a specific approach that highlights the role of students as facilitators and explainers in understanding mathematical concepts. The urgency of this study arises from the urgent need for effective learning methods to improve mathematics learning outcomes, especially amidst learning challenges that require active interaction and in-depth mastery of the material. By identifying the effectiveness of this model, the results of the study can provide guidance for educators in choosing strategies that can increase student engagement and better understanding of mathematics learning.

Based on the description above, the researcher is interested in conducting research with the aim of determining the effect of the Student Facilitator and Explaining type cooperative learning model on students' mathematics learning outcomes.

2. RESEARCH METHOD

2.1. Type of Research

The type of research that will be studied by the author is a quasi-experimental research or better known as Quasi Experiment. Experimental research is a research that is used to find the effect of certain treatments on others under controlled conditions [18]. The research design used by the researcher is Nonequivalent Control Group Design.

Nonequivalent Control Group Design is an experimental design in which the research subjects are not taken randomly to see the differences in initial conditions between the experimental group and the control group [19]-[21]. This study will compare the experimental group with the control group, by means of the experimental group being given treatment, namely by using the Student Facilitator and Explaining learning model, while the control group continues to use the conventional learning model.

2.2. Population and Sample

Population is the totality of all possible values, either the result of calculating or measuring quantitatively or qualitatively of certain characteristics regarding a complete set of objects [22]-[24]. Population can also be said as a subject that meets certain requirements related to the research problem. The population in this study were all students of grade XI of YPPI Tualang private vocational high school which were divided into five classes, namely Industrial Mechanical Maintenance Engineering 1, Industrial Mechanical Maintenance Engineering 2, TOI 1, Computer Network Engineering 1, and Computer Network Engineering 2.

A sample is a part of a population that has certain characteristics or conditions to be studied. The sampling used in this study is Purposive Sampling or consideration sampling. Purposive sampling is a sampling technique used by researchers if researchers have certain considerations in taking samples or determining samples for certain purposes [25]-[27]. In this study, the researcher chose a sample of class XI Teknik Komputer Jaringan 1 and class XI Teknik Otomasi Industri 1. Class XI Teknik Komputer Jaringan 1 as the experimental class and class XI Teknik Otomasi Industri 1 as the control class. The sample was selected based on considerations from the mathematics teacher, curriculum representative and mathematics learning outcomes of class XI students of Sekolah Menengah Kejuruan Swasta YPPI Tualang. Based on the opinion of the mathematics teacher, both classes can be conditioned well, while the curriculum representative stated that of the five existing classes, 2 of them carried out prakerind (industrial work practice) or what is commonly called an internship, then there were 3 classes that did not carry out the internship, namely XI Computer Network Engineering 1, XI Industrial Automation Engineering 1, and XI Industrial Mechanical Maintenance Engineering 2. So from the 3 classes, the curriculum representative suggested choosing class ation Industry 1, and when viewed from the learning outcomes, class XI Computer Network Engineering 1 and class XI Industrial Automation Engineering 1 obtained higher mathematics learning outcomes compared to XI Industrial Mechanical Maintenance Engineering 2.

2.3. Data collection techniques

The data collection technique that will be implemented in this study is the test technique. This test technique is used to collect data on students' mathematics learning outcomes in the experimental class and the control class before and after being given treatment [9], [28], [29]. Students who have participated in learning in both the experimental class and the control class will be given a test in the form of a descriptive test. The results of the test will be analyzed using descriptive statistics and inferential statistics.

The instruments used were pretest and posttest questions. Pretest and posttest questions were used to measure students' mathematics learning outcomes. Pretest questions were used to measure students' learning outcomes before treatment was given to both classes, namely the control class and the experimental class. Meanwhile, posttest questions were used to measure students' mathematics learning outcomes after the two classes were given different treatments.

2.4. Data Analysis Techniques

The data obtained from the pretest and posttest results were then analyzed, the data analysis used was descriptive statistical data analysis and Inferential Statistical Data Analysis. Descriptive statistical analysis aims to describe data on students' mathematics learning outcomes carried out before and after learning activities [30]. The data described is data obtained from measuring test instruments.

Inferential statistics is a statistical technique used to analyze sample data and the results are applied to the population [31],[32]. Thus, it can be concluded that this inferential statistical analysis is used to draw research conclusions in the form of normality tests, variance homogeneity tests, and two-average tests (t-tests).

3. RESULTS AND DISCUSSION

Data analysis techniques in this study are divided into two, namely descriptive statistics and inferential statistics for students' mathematics learning outcomes data and observations for teacher activity data. This test was conducted to see whether or not there was an effect before and after treatment. The pretest and posttest questions given were questions on the sequence material. There were 5 descriptive questions given. The pretest and posttest scores of students in grades XI Computer network Engineering 1 and XI Industrial Automation Engineering 1 were analyzed using inferential statistics, namely by using the normality test, the Mann-Whitney U test (U-Test), the N-Gain data normality test, the Mann-Whitney U Test of N-Gain data.

3.1. Descriptive Statistical Analysis

From the results of the research after the researcher taught at YPPI Tualang vocational high school which was carried out in the experimental class and control class, it can be seen descriptively in the table below:

Table 1. Pretest and Posttest Results Data for Experimental Class and Control Class

Information	Pretest		Posttest	
	Experiment	Control	Experiment	Control
Number of Samples (n)	33	29	29	26
Mean ($\bar{x}$)	16.88	5.96	61.55	46.72
Standard Deviation (s)	22.87	18.84	24.63	22.95

Based on the table above, it can be seen that after being given treatment, the average post-test learning outcomes of the experimental class were better than the average learning outcomes of the control class. This means that SFE type cooperative learning has a better influence compared to conventional learning models.

3.2. Inferential Statistical Analysis

3.2.1. Results of the Normality Test of Pretest Value Data for the Experimental Class and Control Class

This Normality Test aims to see whether the data from each class is normally distributed or not [33],[34]. Because before conducting a homogeneity test, the assumption that must be met is that the data of both classes must be normally distributed. The results of the pretest data normality test can be seen in the following appendix and table:

Table 2. Normality Test of Pretest of Experimental Class and Control Class

Class	X^2_{count}	X^2_{table}	Conclusion
Experiment	187.9	11.07	Not normally distributed
Control	503.9	11.07	Not normally distributed

Based on the research results, it can be seen that the value X^2_{count} the experimental class was 187.9 and X^2_{count} the control class was 503.9. With degrees of freedom (dk) = 6 (number of class intervals) – 1 = 5 and a significance level of α = 0.05, we obtain X^2_{table} for both classes is 11.07. For the experimental class X^2_{hitung} = 187,9 > X^2_{table} = 11,07 then H_0 is rejected and H_1 is accepted. This means that the experimental class pretest value data comes from a population that is not normally distributed. For the control class, X^2_{count} = 503,9 > X^2_{table} = 11,07 then H_0 is rejected and H_1 is accepted. This means that the pretest value data of the control class comes from a population that is not normally distributed. Because X^2_{count} > X^2_{table} for the experimental and control classes, then H1 is accepted. This states that the pretest scores for both classes come from a population that is not normally distributed.

3.2.2. Non-Parametric Test Results of Pre-test Data Values of Experimental Class and Control Class

After the researcher conducted a normality test on the pretest value data, the data obtained from both groups were not normally distributed. So a nonparametric test was conducted, one of which was the Mann Whitney U (U-Test). The researcher chose to use this test because the Mann Whitney U (U-Test) test is one of the non-parametric tests that is considered strong to see whether or not there is a difference in the average mathematics learning outcomes of students between the experimental class and the control class. To determine whether or not there is a difference in the average of the two classes, it is done by looking at the comparison $|Z_{count}|$ dengan $|Z_{table}|$. After the calculations are carried out, the results can be seen in the table below:

Table 3. Mann Whitney U-Test Data Pretest Scores of Experimental Class and Control Class

Class	N	$\lvert Z_{count}\rvert$	$\lvert Z_{table}\rvert$
Experiment	33	6.74	1.96
Control	29		

The criteria for testing the equality of two average pre-test scores are: if $|Z_{count}|| < |Z_{table}|$ then H_0 is accepted and H_1 is rejected and if $|Z_{count}| \geq |Z_{table}|$ then H_0 is rejected and H_1 is accepted.

After obtaining Z_{count}, with a real level of α = 0.05, the degree of freedom (dk) = (1 – 1/2 α) = 1 – 1/2 . 0.05 = 1 − 0.025 = 0.975, in the normal distribution table $Ztabel$ with an area of 0.975 is 1.96. From the calculation obtained $|Z_{count}|$= |6,74| > $|Z_{table}|$= |1,96|. This means that H0 is rejected and H1 is accepted, so it can be concluded that there is a difference in the average mathematics learning outcomes of students in the experimental class and the control class. Because the results of the Mann Whitney U-Test pre-test data show that there is a difference in the average mathematics learning outcomes of students in the experimental class and the control class, an N-Gain data analysis was carried out to see the effect of treatment on both classes.

3.2.3. Results of the Normality Test of Post-test Data for Experimental and Control Classes

This normality test aims to see whether the data from each class is normally distributed or not. Because before conducting a homogeneity test, the assumption that must be met is that the data of both classes must be normally distributed. The results of the post-test data normality test can be seen in the appendix and table below:

Table 4. Post-test Normality Test for Experimental Class and Control Class

Class	X^2_{count}	X^2_{table}	Conclusion
Experiment	68.09	11.07	Not normally distributed
Control	51.75	11.07	Not normally distributed

Based on the research results, it can be seen that the value X^2_{count} the experimental class was 68.09 and X^2_{count} control class is 51.75. With degrees of freedom (dk) = 6 (number of class intervals) – 1 = 5 and a real level of $\alpha = 0.05$, then obtained X^2_{table} for both classes is 11.07. For the experimental class $X^2_{count} = 68,09 > X^2_{table} = 11.07$ then H_0 is rejected and H_1 is accepted. This means that the pretest value data of the experimental class comes from a population that is not normally distributed. For the control class, $X^2_{count} = 51,75 > X^2_{table} = 11.07$ then H_0 is rejected and H_1 is accepted. This means that the post-test value data of the control class comes from a population that is not normally distributed. Because $X^2_{count} > X^2_{table}$ for the experimental and control classes, then H_1 is accepted. This states that the posttest scores for both classes come from a population that is not normally distributed.

Based on the normality test of the pretest and posttest data, it was obtained that the pretest and posttest data were not normally distributed. So it was continued with the Mann Whitney U (U-Test) test. In the results of the Mann Whitney U (U-Test) test, the pretest score data showed that there was a difference in the average mathematics learning outcomes of students in the experimental and control classes, so to see the effect of treatment on the two classes, N-Gain data analysis was carried out.

3.2.4. Inferential Analysis of N-Gain Data

N-Gain data was obtained from the pretest and posttest scores of each experimental class and control class. The N-Gain data can be seen in appendix M1 for the experimental class and appendix M2 for the control class. The data is summarized in the table below:

Table 5. N-Gain Data for Experimental Class and Control Class

Class	N	Σx	N-Gain	Interpretation
Experiment	33	19.6	0.59	Medium
Control	29	14.31	0.49	Medium

Based on the table above, it can be seen that both classes are in moderate interpretation. The average N-Gain of the experiment is higher than the average N-Gain of the control class. This shows that the mathematics learning outcomes of students in the experimental class are better than the mathematics learning outcomes of students in the control class.

3.2.5. Results of N-Gain Data Normality Test for Experimental Class and Control Class

The data analyzed in this normality test are the N-Gain data of the experimental class and the N-Gain data of the control class. The normality test aims to determine whether the data of each class is normally distributed or not. One of the assumptions that must be met before the homogeneity of variance test is that the N-Gain data of both classes are normally distributed after receiving different treatments. The results of the N-Gain data normality test can be seen in appendices N1 and N2 and are summarized in the following table:

Table 6. Normality Test of N-Gain Data for Experimental Class and Control Class

Class	X^2_{count}	X^2_{table}	Conclusion
Experiment	70.315	11.07	Not normally distributed
Control	62.9	11.07	Not normally distributed

The criteria for testing the normality of N-Gain data is if $X^2_{count} \leq X^2_{table}$ then H_0 is accepted and H_1 is rejected, meaning the data is normally distributed and if $X^2_{count} > X^2_{table}$ then H_0 is rejected and H_1 is accepted, meaning the data is not normally distributed. Based on the results of the researcher's calculations in the table, the value of $x\ 2\ hitung$ of the experimental class is 70.315 and X^2_{count} control class of 62.9 with degrees of freedom (dk) = 6 (number of interval classes) – 1 = 5 and a significance level of $\alpha = 0.05$, obtained X^2_{table} for both classes was 11.07. Conclusion: For the experimental class, the obtained $X^2_{count} > X^2_{table}$, then H_0 is rejected and H_1 is accepted, meaning that the N-Gain data for the experimental class is not normally distributed. Furthermore, for the control class, it is obtained $X^2_{count} > X^2_{table}$, then H_0 is rejected and H_1 is accepted, meaning that the N-Gain data for the experimental class is not normally distributed.

3.2.6. Mann Whitney U-Test Analysis of N-Gain Data of Experimental Class and Control Class

Since the data is not normally distributed, the statistical test used is the Mann Whitney U test (U-Test) with N-Gain data for the experimental class and control class. The results of the Mann Whitney U-Test for N-Gain data for the Experimental Class and Control Class can be seen in the following table:

Table 7. Mann Whitney U-Test N-Gain Data for Experimental Class and Control Class

Class	N	$\lvert Z_{count}\rvert$	$\lvert Z_{table}\rvert$
Experiment	33	6.74	1.96
Control	29		

The criteria for testing the equality of two average post-test scores are: if $|Z_{count}|| < |Z_{table}|$ then H_0 is accepted and H_1 is rejected and if $|Z_{count}|| \geq |Z_{table}|$ then H_0 is rejected and H_1 is accepted. After obtaining Z_{count}, with a real level of $\alpha = 0.05$, the degree of freedom (dk) = $(1 - 1\ 2\ \alpha) = 1 - 1\ 2\ .\ 0.05 = 1 - 0.025 = 0.975$, in the normal distribution table Z_{table} with an area of 0.975 is 1.96. Because the results of the Mann Whitney U-Test of the N-Gain data show that the value $||Z_{count}|| = |6,74| > |Z_{table}| = 1.96$. This means that H_0 is rejected and H_1 is accepted, so it can be concluded that there is a difference in mathematics learning outcomes between students who receive cooperative learning of the Student Facilitator and Explaining type and students who receive conventional learning.

Learning with the student facilitator and explaining model provides students to design and explain the material to their friends in front of the class using concept maps or charts. This learning model will be relevant if students actively participate in designing the material presented. Students discuss concept maps in their respective groups before the learning meeting. In this case, it can make students teachers for their friends and students can better understand the material because there is an explanation of the material in outline by the mathematics teacher and there is a detailed explanation by students chosen by the teacher to explain the material in front of the class. In addition, with group activities, it can make it easier for students to find solutions to problems on the student worksheets.

Meanwhile, in the control class that received conventional learning, students also looked active in implementing the learning. Similar to the experimental class, students in the control class were initially still not seen to be active and were still confused in working on the questions given. However, in the next meeting, students had shown activeness in the learning process. This certainly also has an impact on students' mathematics learning outcomes.

This study has significant implications for informing learning approaches that can improve students' understanding and engagement in learning mathematics. By demonstrating the effectiveness of the Student Facilitator and Explaining model, this study can help teachers in choosing methods that encourage students' active participation and improve their learning outcomes, thus potentially improving the overall quality of mathematics education. However, this study also has limitations, including the limited generalizability of the research results because they may only apply to certain groups or environments. In addition, the effectiveness of this model may be influenced by students' communication skills and basic abilities, as well as teachers' expertise in implementing cooperative methods, all of which may vary in each class or school. This suggests that the research results need to be further studied in different educational contexts and environments.

4. CONCLUSION

Based on the results of data analysis, it can be concluded that there is a difference in mathematics learning outcomes between students who receive cooperative learning of the Student Facilitator and Explaining type and students who receive conventional learning in class XI of YPPI private vocational high school, meaning that there is an influence of the Student Facilitator and Explaining learning model on the mathematics learning outcomes of class XI students of YPPI Tualang private vocational high school. Recommendations for further research are suggested to examine more deeply the influence of this model on various other aspects of mathematics learning, such as critical thinking skills, problem solving, and student collaboration. Further research can also expand the study by involving various levels of education and different learning environments to see whether the effectiveness of this model is consistent in a broader context.

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REFERENCES

[1] J. Kilpatrick, "History of research in mathematics education," *Encycl. Math. Educ.*, pp. 349–354, 2020.
[2] K. Lavidas, Z. Apostolou, and S. Papadakis, "Challenges and opportunities of mathematics in digital times: Preschool teachers' views," *Educ. Sci.*, vol. 12, no. 7, p. 459, 2022.
[3] T. Dahlan, D. Darhim, and D. Juandi, "How Digital Applications as Mathematics Learning Media in The Automation Era," *J. Posit. Psychol. Wellbeing*, vol. 6, no. 2, pp. 199–211, 2022.
[4] I. Ayuwanti and D. Siswoyo, "Teacher-student interaction in mathematics learning.," *Int. J. Eval. Res. Educ.*, vol. 10, no. 2, pp. 660–667, 2021.
[5] H. E. Putri, M. A. Wahyudy, A. Yuliyanto, and F. Nuraeni, "Development of instruments to measure mathematical anxiety of elementary school students," *Int. J. Learn. Teach. Educ. Res.*, vol. 19, no. 6, pp. 282–302, 2020.
[6] A. Abassian, F. Safi, S. Bush, and J. Bostic, "Five different perspectives on mathematical modeling in mathematics education," *Investig. Math. Learn.*, vol. 12, no. 1, pp. 53–65, 2020.
[7] L. F. Jawad, "Mathematical connection skills and their relationship with productive thinking among secondary school students," *Period. Eng. Nat. Sci.*, vol. 10, no. 1, pp. 421–430, 2022.
[8] D. H. Tong, B. P. Uyen, and N. V. A. Quoc, "The improvement of 10th students' mathematical communication skills through learning ellipse topics," *Heliyon*, vol. 7, no. 11, 2021.
[9] L. L. Paroqi, M. Mursalin, and M. Marhami, "The Implementation of Realistic Mathematics Education Approach to Improve Students' Mathematical Communication Ability in Statistics Course," *Int. J. Educ. Vocat. Stud.*, vol. 2, no. 10, 2020.
[10] B. P. Uyen, D. H. Tong, and N. T. B. Tram, "Developing Mathematical Communication Skills for Students in Grade 8 in Teaching Congruent Triangle Topics.," *Eur. J. Educ. Res.*, vol. 10, no. 3, pp. 1287–1302, 2021.
[11] J. Filgona, J. Sakiyo, D. M. Gwany, and A. U. Okoronka, "Motivation in learning," *Asian J. Educ. Soc. Stud.*, vol. 10, no. 4, pp. 16–37, 2020.
[12] Y.-C. Ma, "Using Participatory Teaching in Hands-On Courses: Exploring the Influence of Teaching Cases on Learning Motivation," *Educ. Sci.*, vol. 13, no. 6, p. 547, 2023.
[13] I. Fauzi and L. S. Sabila, "Implementation of Student Facilitator and Explaining (SFE) Strategies in Islamic Education Learning," *J. Islam. Educ. Res.*, vol. 3, no. 2, pp. 149–158, 2022.
[14] S. Samad and A. L. Setyabudhi, "Application of Video-Based Learning Media with Applications to Improve Learning Activities of Vocational High School Students," *Tech. Vocat. Educ. Int. J.*, vol. 3, no. 1, pp. 22–27, 2023.
[15] E. S. Boye and D. D. Agyei, "Effectiveness of problem-based learning strategy in improving teaching and learning of mathematics for pre-service teachers in Ghana," *Soc. Sci. Humanit. Open*, vol. 7, no. 1, p. 100453, 2023.
[16] R. Safitri, A. S. Wahyuri, and Y. Ockta, "The Impacts of the Project-Based Learning and Problem-Based Learning Models with Self-Confidence on Students' Learning Outcomes," *Indones. Res. J. Educ. IRJE|*, vol. 8, no. 1, pp. 269–283, 2024.
[17] M. Pratiwi, "Student Tutoring, Facilitator and Explaining Models: A Problem Solving Metacognition towards Learning Achievements of Informatics Students," *J. Educ. Sci.*, vol. 4, no. 2, pp. 368–379, 2020.
[18] M. Gopalan, K. Rosinger, and J. Bin Ahn, "Use of Quasi-Experimental Research Designs in Education Research: Growth, Promise, and Challenges," *Rev. Res. Educ.*, vol. 44, no. 1, pp. 218–243, 2020, doi: 10.3102/0091732X20903302.
[19] A. Singh, "Quasi experimental design in scientific psychology," *SSRN Electron. Journal. https//doi. org/10.2139/ssrn*, vol. 3793568, 2021.
[20] H. J. Banda and J. Nzabahimana, "The impact of physics education technology (PhET) interactive simulation-based learning on motivation and academic achievement among malawian physics students," *J. Sci. Educ. Technol.*, vol. 32, no. 1, pp. 127–141, 2023.
[21] M. Laure and K. Habe, "Stimulating the development of rhythmic abilities in preschool children in Montessori kindergartens with music-movement activities: A quasi-experimental study," *Early Child. Educ. J.*, vol. 52, no. 3, pp. 563–574, 2024.
[22] H. M. Levitt, "Qualitative generalization, not to the population but to the phenomenon: Reconceptualizing variation in qualitative research.," *Qual. Psychol.*, vol. 8, no. 1, p. 95, 2021.
[23] A. P. Nugraha, "The effect of transformational leadership style, transactional leadership and charismatic leadership on organizational citizenship behavior (ocb) with working culture as an intervening variable," in *IAIC International Conference Series*, 2021, pp. 100–112.
[24] A. Wapa, "Influence of Creative Problem Solving To Study Result Social Sciences Study As Reviewed From the Multicultural Attitude of Students Class V Elementary South Kuta," *PrimaryEdu J. Prim. Educ.*, vol. 4, no. 2, pp. 160–171, 2020.
[25] F. Nyimbili and L. Nyimbili, "Types of purposive sampling techniques with their examples and application in qualitative research studies," *Br. J. Multidiscip. Adv. Stud.*, vol. 5, no. 1, pp. 90–99, 2024.
[26] G. K. Mweshi and K. Sakyi, "Application of sampling methods for the research design," *Arch. Bus. Res.*, vol. 8, no. 11, pp. 180–193, 2020, doi: 10.14738/abr.811.9042.
[27] E. Bakkalbasioglu, "How to access elites when textbook methods fail: Challenges of purposive sampling and advantages of using interviewees as 'fixers.,'" *Qual. Rep.*, vol. 25, no. 3, pp. 688–699, 2020.
[28] A. Fathurohman *et al.*, "Effectiveness of Using the Mobile Learning App for STEM-Based High School Physics Materials as Indonesian Student Learning Resources on Learning Outcomes," *J. Penelit. Pendidik. IPA*, vol. 9, no. 3, pp. 1018–1023, 2023.
[29] L. Parnabhakti and N. D. Puspaningtyas, "Penerapan Media Pembelajaran Powerpoint Melalui Google Classroom Untuk

Meningkatkan Hasil Belajar Siswa," *J. Ilm. Mat. Realis.*, vol. 1, no. 2, pp. 8–12, 2020, doi: 10.33365/ji-mr.v1i2.459.
[30] A. R. Nasution and A. B. D. Nandiyanto, "Utilization of the google meet and quiziz applications in the assistance and strengthening process of online learning during the COVID-19 pandemic," *Indones. J. Educ. Res. Technol.*, vol. 1, no. 1, pp. 31–34, 2021.
[31] O. Rahmayani, S. Ardi, and R. Nofrialdi, "The Effect of Utilization of Social Media Instagram@ Nanarfshop on Buying Interest of Fisipol Students University Ekasakti Padang," *J. Law, Polit. Humanit.*, vol. 2, no. 2, pp. 85–94, 2022.
[32] D. A. Kurniawan, D. Darmaji, A. Astalini, and S. M. Husna, "A study of critical thinking skills, science process skills and digital literacy: reviewed based on the gender," *J. Penelit. Pendidik. Ipa*, vol. 9, no. 4, pp. 1741–1752, 2023.
[33] I. Supena, A. Darmuki, and A. Hariyadi, "The influence of 4C (constructive, critical, creativity, collaborative) learning model on students' learning outcomes," *Int. J. Instr.*, vol. 14, no. 3, pp. 873–892, 2021, doi: 10.29333/iji.2021.14351a.
[34] E. Nurlinda, Z. Azis, and M. D. Nasution, "Students' Mathematical Reasoning Ability and Self-Efficacy Viewed from the Application of Problem Based Learning and Contextual Teaching and Learning Models Assisted," *JMEA J. Math. Educ. Appl.*, vol. 3, no. 2, pp. 54–61, 2024.