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Enhancing Process Skills and Learning Outcomes: A Comparative Study of the Treffinger Learning Model

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Abstract

The Treffinger Model is an instructional approach developed with the primary goal of stimulating creativity and building process skills skills in students. This study aims to assess the extent to which the Treffinger Model enhances process skills abilities and student learning outcomes in addressing complex geographical challenges. A quantitative approach, specifically quasi-experimental design, was adopted to compare the effectiveness of the Treffinger Model with conventional teaching methods. The research involved two groups of eighth-grade students, with one group taught using the Treffinger Model and the other group through conventional methods. Data were collected for process skills and learning outcomes through pre-test and post-test assessments. The findings of this research indicate that the Treffinger Model has a significant positive impact on students' process skills and learning outcomes. The analysis of process skills reveals that students exposed to the Treffinger Model demonstrated improved abilities in observation, communication, grouping, measurement, drawing conclusions, and prediction. Additionally, the analysis of learning outcomes reveals that students taught with the Treffinger Model achieved higher average scores compared to those taught using conventional methods. The novelty of this research lies in its exploration of innovative pedagogical approaches and their impact on students' process skills abilities to comprehend and analyze geographical concepts more deeply. The benefit to the advancement of knowledge is the potential to increase students' interest and produce a generation of individuals who are more aware and knowledgeable about geographical issues.

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INTRODUCTION

This era of globalization has ignited a race among nations to enhance their human capital to effectively engage in the global competition of the 21st century (Widiari et al., 2014; Sudirtha et al., 2021). One crucial aspect in facing the challenges of the 21st century is possessing scientific literacy, which encompasses an individual's capacity to comprehend and apply scientific principles in everyday situations (Adystia et al., 2022). As such, acquiring the essential competencies demanded by the contemporary world has become a vital endeavor (Widiari et al., 2014; Sudirtha et al., 2021). Recognizing the significance of education, public authorities have taken substantial steps to improve both the quality and quantity of education. A central objective of these efforts is to develop educational institutions that produce graduates poised to excel on the international stage (Pujilestari, 2020;. Ramadhan et al., 2021)

Education, closely intertwined with learning and teaching, encompasses a spectrum of activities that extend beyond mere knowledge transfer. It encompasses the entire gamut of learning implementation and content delivery, thereby equipping students with enduring scientific skills (Nasution, 2015; Rahmadhani & Ahmad, 2022). In this context, the educational journey continually aims for gratifying learning outcomes, making the educational cycle an evolving process (Zulkarnaen et al., 2021; Nurjanah, 2022). While educators play a pivotal role in this cycle, factors such as students' comprehension of material and educators' ability to present material effectively also play a critical role.

Learning, an indispensable facet of education, serves as a pivotal conduit in the education system. The ultimate goal of the teaching and learning process is to optimize learning outcomes. This hinges upon an intricate interplay of factors including motivation, curiosity, and engagement (Nahar, 2016). Additionally, the persistent reliance on conventional lecture-based teaching methods limits learning outcomes (Wulandari, 2020; Lasaiba, 2023). Here, the pivotal role of teachers is evident; their quality profoundly influences the learning journey and serves as a cornerstone of educational success (Geni, et al.,2020). The teaching and learning activities in schools are intricately connected to the instructional models employed by educators for their students.(Hanifa et al., 2023)

To propel learning into a more effective realm, the Treffinger Model emerges as a promising pedagogical approach. This model, underpinned by creative problem-solving and active participation, holds the potential to revolutionize the learning experience (Irawan et al., 2020;.Ridhiyani et al., 2022). It empowers students with skills necessary for addressing complex issues, spanning various levels of reasoning (Ngalimun 2014; Herianto & Sahrup, 2019). At its core, the Treffinger Model is student-centered, aligning with Donald J. Treffinger's vision of fostering creative problem-solving skills (Treffinger, 1995; Zulkarnaen et al., 2021). This model is a learning model that combines the capacities at each stage, explicitly recognizing current issues, coming up with ideas, and becoming ready to act (Utami & Nugraheni, 2019).

The use of the Treffinger learning model has been developed through various approaches and methods. Some of these include measuring students' process skills abilities (Ridwan, 2019). applying the Realistic Mathematics Education (RME) principles to creative thinking skills by considering numerical ability (Ndiung et al., 2019), enhancing creative reasoning and problem-solving skills as well as student learning interests (Kusuma et al., 2020; Lasaiba & Arfa, 2023), and developing teaching tools to improve creative thinking (Handayani et al., 2018). The implementation of the Treffinger model has been used to assess students' divergent thinking skills (Wirahayu, Purwito, and Juarti, 2018), and has aided in understanding concepts using instructional materials like Alqurun (Yulinsa et al., 2021). The model has also proven effective in developing creative thinking skills based on students' learning styles through an open-ended approach (Triwibowo et al., 2017). and in assessing students' connection abilities considering their learning resilience (Rohmah et al., 2020). The application of this model has also been successful in enhancing the effectiveness of implementation for improved learning outcomes (Utama & Sudarsana 2023), and has played a role in improving higher-order thinking skills in natural science subjects for students (Annuuru et al., 2017).

Geography, an integral subject in secondary school curricula, assumes critical importance in fostering a comprehensive understanding of the world. This subject offers insights into the values, mental frameworks, and practical skills required for responsible interactions with the environment (Wara et al., 2015; Susilawati & Sochiba, 2022b). Engaging students in both classroom and experiential learning amplifies their grasp of geographical concepts, an approach termed naturalistic learning (Hermayuni et al., 2021; Lasaiba & Lasaiba, 2022). Rooted in the scientific tenets of geography, this methodology harnesses students' interaction with the environment for a deeper understanding.

The gap in the implementation of the Treffinger learning model in geography education lies in the challenge of integrating geographical aspects that require a deep understanding of concepts and geographic contexts. This model has not fully met the needs of geography teaching, which often involves in-depth analysis, field observations, and interpretation of geographic data. Therefore, there is a need for expansion to enable the model to incorporate these elements in order to facilitate understanding and geographic analysis. The aim of this research is to evaluate the implementation of the Treffinger Model in geography education, specifically among high school-level students. This study aims to comprehend the extent to which this model can enhance students' process skills abilities and learning outcomes in tackling complex geographical challenges. Through this study, it is hoped that new insights can be discovered regarding the effectiveness and adaptability of the Treffinger Model in the context of geography education, as well as its impact on students' learning experiences.

METHODS

This research adopts a quantitative method. The type of research conducted is a quasi-experimental study using a pretest-posttest control group design. The use of quasi-experimental method was chosen to analyze cause-and-effect relationships in the implementation of learning. This is due to limitations in meeting research criteria related to random subject selection. Through this design, we aim to analyze the impact of the learning treatment given to the experimental group compared to the control group through the collection of data before (pretest) and after (posttest) the treatment.

This research was conducted at State Junior High School 14 with samples taken from eighth-grade students. The independent variable studied is the Treffinger learning model, while the dependent variables involve process skills and student learning outcomes. The research population includes all eighth-grade classes in the school, and the sample consists of two classes: class VIII 1 implementing the Treffinger learning model (experimental group) and class VIII 2 implementing the conventional learning model (control group). The sample selection is part of the experimental research design. In this design, two classes are randomly selected for each group, and each class consists of 30 students. After the random selection, the two chosen classes are further randomized to determine the group that will receive treatment with the Treffinger model and the group that will receive treatment with the conventional model.

Data regarding process skills are collected by comparing students who have received specific treatment and students who have not received similar treatment. The analysis is based on the level of mastery in six aspects of process skills: observation, communication, grouping, measurement, drawing conclusions, and prediction. To obtain information about student learning outcomes, data is collected through a learning outcomes test consisting of 20 questions. This test is designed to measure students' understanding and achievement related to the subject matter. Each question in the test contributes to assessing the extent to which students have mastered the taught material and skills. The data collection aims to understand the differences in process skills between the group of students receiving special treatment and the group not receiving similar treatment. Additionally, the learning outcomes test helps assess the extent to which students have successfully understood the material and applied the taught skills. This data serves as a foundation for analyzing the impact of the treatment on students' process skills and learning outcomes.

Furthermore, data analysis is conducted using the Statistical Products and Solution Services (SPSS) software. This analysis includes a general description of the research results by comparing the mean and standard deviation of process skills and student learning outcomes in the experimental and control groups at the pretest and posttest stages. Additionally, classical assumption tests are performed, such as the Kolmogorov-Smirnov and

Shapiro-Wilk tests for normality, as well as the Levene test and Variance/Covariance Matrix using Box's M for homogeneity testing. Subsequently, a test for multicollinearity is conducted using the variance inflation factor (VIF) to identify multicollinearity issues.

Continuing from the previous stages, after performing descriptive analysis and testing classical assumptions, the next step is to conduct hypothesis testing. This hypothesis testing aims to examine the differences in process skills and learning outcomes between students who use the Treffinger method and those who use conventional teaching methods. For this purpose, Multivariate Analysis of Variance (MANOVA) is employed. In the MANOVA analysis, metrics such as Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root are used to test the influence of the independent variable (type of teaching method) on a set of dependent variables (process skills and learning outcomes). This analysis provides a more comprehensive understanding of the potential differences that may arise in several dependent variables simultaneously, based on variations in the independent variable. The results of this analysis will assist in identifying whether the Treffinger teaching method has a significant impact on students' process skills and learning outcomes compared to the conventional teaching method.

Additionally, the study is conducted using the Least Significant Difference (LSD) method. LSD is a statistical method that helps compare differences among several groups in a research study after significant differences are found in statistical analysis. This method is useful for identifying pairs of groups with significant average differences. In the context of this research, LSD is employed to understand the differences between the group of students following the cooperative learning model (Treffinger model) and the group of students following the conventional learning model in terms of process skills. LSD provides information on whether the average difference between these two groups exceeds a critical value, indicating that the difference is statistically significant. The significance test compares the average process score pairs between the cooperative learning model (Treffinger model) group and the traditional learning model group applied in the "Between-Subjects Effects" for each dependent variable. LSD helps identify significant differences among the tested groups.

In the "Between-Subjects Effects" analysis, Partial Eta Square measures how much variability in the dependent variable can be explained by the independent variable. Type II Sum of Squares measures the unique contribution of the independent variable to the dependent variable, while controlling for other independent variables in the model. Observed Power gauges the statistical strength of the hypothesis test in detecting significant differences. The values of degrees of freedom (df) and Mean Square are used in calculating the F-value, which compares the between-group variability to within-group variability. The F-value is then used to test the significance of the differences among the groups.

To estimate the average learning outcomes scores between the experimental and control groups, both in the pre-test and post-test stages, the method of Mean Difference I-J is employed. This method involves calculating the average score difference between the two compared groups. The standard error value is computed to measure the extent to which the estimated average may fluctuate. Furthermore, the significance value is considered to determine whether the average difference is statistically significant. The significance value indicates the likelihood that the difference may occur by chance. If the significance value is less than the established significance level (usually 0.05), the difference is considered significant. The 95% confidence interval is also an integral part of this analysis. This interval provides a range of values within which the actual average is estimated to fall with 95% confidence. The lower bound and upper bound of this confidence interval provide information about the accuracy of the average estimation. In other words, this analysis offers insights into the magnitude of the average differences between the experimental and control groups in both stages (pre-test and post-test), the stability of the average estimation (standard error), the significance of the difference (significance), and the confidence interval within which the actual average is likely to lie.

RESULTS AND DISCUSSION

The research results in the section will present general descriptions of process skills, learning outcomes, prerequisite tests, and hypothesis testing. The general description of the research results compares the average value and standard deviation of process skills and student science learning outcomes. The average score, standard deviation, variance, minimum, maximum, and total score are all described in the descriptive analysis of the process skills data. Table 1 below shows the findings of the descriptive analysis of the students' science process skills data.

Table 1. Results of Data Process Skills Descriptive Analysis

		Observation	Communicati	Grouping	Measureme	Conclusion
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0
Mean		67.00	68.17	75.17	66.00	67.00
Median		71.00	71.00	76.00	66.00	71.00
Std. deviation		7.220	5.527	6.806	6.958	7.458
Variance		50.790	29.554	45.971	49.276	55.138
Range		20	20	20	20	20

Table 1 shows the comparison of process skills between students who received treatment and those who did not, seen from the results of process skills based on the level of mastery of 6 aspects: observation, communication, grouping, measurement, concluding, and predicting. Data on student learning outcomes were obtained from the results of the learning outcomes test, which consisted of 20 questions. Descriptive analysis of learning outcomes data describes the average score, standard deviation, variance, minimum, maximum, and total score. The results of the descriptive analysis of student learning outcomes data can be seen in Table 2.

Table 2. Descriptive Analysis of Study Results Outcomes

		Pre-Test Control	Post-Test Control	Pretest Experiment	Post-Test Experiment
N	Valid	29	29	29	29
	Missing	0	0	0	0
Mean		65.68	73.13	69.30	78.44
Median		65.00	75.00	70.00	80.00
Std. Deviation		5.934	6.142	5.937	7.209
Variance		35.223	37.696	35.223	51.971
Range		20	25	20	30
Minimum		54	61	61	61
Maximum		76	86	81	91

The comparison of learning results between the experimental and control class can be observed in Table 2. The information in Table 2 above describes the learning outcomes of the experimental and control classes based on the post-test data. Test for Prerequisite Preliminary tests are conducted, such as before the theory is put to the test.

Classic Assumption Test

Test The normality test is carried out with *Kolmogorov-Smirnov and Shapiro-Wilk* As stated in Table 3 below,

Table 3. Normality Test

	Class	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
HB	Pretest Control	.178	30	.016	.910	30	.015
	Post-test Control	.188	30	.008	.918	30	.024
	Pretest Eksperimen	.238	30	.000	.922	30	.029
	Post-test Experiment	.204	30	.003	.917	30	.023
KP	Pretest Control	.203	30	.003	.905	30	.011
	Post-test Control	.208	30	.002	.909	30	.014
	Pretest Experiment	.204	30	.003	.922	30	.030
	Post-test Experiment	.195	30	.005	.921	30	.029

a. Lilliefors Significance Correction

The data on process skills and student learning outcomes in Table 3 above achieved a significance level above 0.05, indicating that they came from a normal distribution. Levene's Test of Equality of Error Variances Table 4 was used to conduct the homogeneity test of variance for process skills and learning outcomes.

Table 4. Table of Variance Results of the Homogeneity Test for Process Skills and Learning Objectives

Levene Statistic		df1	df2	Sig.
HB	.361	3	116	.781
	.312	3	116	.816
	.312	3	104.817	.816
	.301	3	117	.826
KP	.113	3	117	.954
	.148	3	117	.933
	.147	3	114.054	.933
	.111	3	117	.955

The learning outcomes and process skills have more significance than 0.05, as shown in Table 4 above. In particular, learning outcomes have a significance of 0.933, and process skills have a value of 0.816. Thus, learning outcomes and process skills have a homogenous distribution. A homogeneous matrix Levene's Equality of Error Test Variant homogeneity test on process skills and learning outcomes was conducted using variances. Table 5.

Table 5. Summary of Variant Matrix/Kovar Homogeneity Test Results

Box's Test of Equality of Covariance Matrices	
Box's M	8.978
F	.967
df1	9
df2	154203.165
Sig.	.467

Table 5 shows that *Box's M* has a value of 8978 with a significance of 0.467. Thus, because the significance of *Box's M* is more significant than 0.05, the variance/covariance matrix of the dependent variable is the same. The multicollinearity test was conducted to determine whether there is a high enough relationship between the variable process skills and student learning outcomes. If no connection is high enough, then there are no aspects of similarity that are measured on these variables, so further analysis can be carried out. The technique used to determine multicollinearity is the guideline used is *variance inflation factor (VIF*) or tolerance. The test is considered to have failed if the independent variable's VIF value is more significant than 10.0, which indicates that the independent variable is multicollinear. Table 6 displays the findings of the analysis.

Table 6 Matrix of Intercorrelation Between

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	View
1	(Constant)	-3.443	1.145		- 3.009	.004		
	HB	.086	.011	.604	8151	.000	.997	1.005
	KP	-.004	.013	-.017	-.212	.834	.997	1.005

Table 6 above shows that the tolerance value between process skills and learning outcomes is more than 0.1 and VIF is less than 10.0, so the multicollinearity of the variable is collinear so that *MANOVA* can be continued.

Hypothesis Testing

The first hypothesis is that there are differences in learning outcomes between students who use the Treffinger method with conventional methods and are then processed with Multivariate Analysis of Variance (MANOVA).

Table 7. Below Is the Manova Test Summary.

Effect		Value	F	Hypothesis df	Sig.	Observed Powerd
Intercept	Pillai's Trace	.996	13575.575b	2.000	.000	1.000
	Wilks' Lambda	.004	13575.575b	2.000	.000	1.000
	Hotelling's Trace	236.097	13575.575b	2.000	.000	1.000
	Roy's Largest Root	236.097	13575.575b	2.000	.000	1.000
Class	Pillai's Trace	.370	8.773	6.000	.000	1.000
	Wilks' Lambda	.631	9.920b	6.000	.000	1.000
	Hotelling's Trace	.583	11.079	6.000	.000	1.000
	Roy's Largest Root	.581	22.447c	3.000	.000	1.000

Based on Table 7 above, the analysis's findings indicate that the calculated value is = 12.85, with a significance level of less than 0.05 for Pillai's Trace, Wilks' Lambda, Ho- telling's, and Roy's Largest Root. Thus, there are differences between scientific students who are taught using the Cooperative learning model of the Treffinger model and students who are taught conventionally in terms of process skills and learning outcomes. Based on the results of the test for Between-subjects Effects, MANOVA analysis was employed to assess the second and third hypotheses. Table 7 below provides a summary of the test results for between-subjects effects.

According to Table 8 above, the student's science process skills have an F value of 0.116, considerably lower than 0.05 at the source. Treffinger cooperative learning model and traditional learning students. Treffinger cooperative learning approach and classes of pupils who adhere to traditional learning. Additionally, a Least Significant Difference (LSD) method study of the importance of the variation in the average score of the process skills between the cooperative learning model (Treffinger model) and the traditional learning model is offered. 30, N = 60, 2 model groups, 30 total samples, and t (0.025; 58) = 2.00 for the statistical value of the table. The rejection limit is determined to be LSD = 0.032 utilizing the statistical value of the t table and for the dependent variable of process skills.

Tests of Between-Subjects Effects								
Source	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**	**Observed Power**
Corrected	KP	17.292a	3	5.764	.116	.951	.003	.070
Model	HB	2748.567b	3	916.189	22.413	.000	.367	1.000
Intercept	KP	699976.875	1	699976.875	14045.954	.000	.992	1.000
	HB	620065.633	1	620065.633	15168.842	.000	.992	1.000
Kelas	KP	17.292	3	5.764	.116	.951	.003	.070
	HB	2748.567	3	916.189	22.413	.000	.367	1.000
Error	KP	5780.833	116	49.835				
	HB	4741.800	116	40.878				
Total	KP	705775.000	120					
	HB	627556.000	120					
Corrected To-	KP	5798.125	119					
tal	HB	7490.367	119					

Table 8 below summarises the findings from the significance test that compared the average pair process score between the cooperative learning model group Treffinger model and the traditional learning model. According to Table 8 above, the average process skill score difference between the experimental and control classes is less than 0.05, with a standard deviation of 1.1817. Therefore, at a significance level of 0.05, the average score of the experimental group's process skills was substantially different. The experimental group's process skills average score was statistically more significant than the control group's average score. Displays the difference in the average score of process skills between the experimental-based group of students and those who follow traditional learning. Thus, Treffinger learning shows differences in learning outcomes compared to the students who practice conventional learning.

Table 9. Estimated Learning Outcomes Average Score

LSD					
(I) Kelas	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Pre-test control	-3.334*	1.652	.047	-6.61	-.07
	-7.368*	1.652	.000	-10.65	-4.11
	-12.834*	1.652	.000	-16.11	-9.57
Post-test control	3.334*	1.652	.047	.07	6.61
	-4.034*	1.652	.017	-7.31	-.77
	-9.501*	1.652	.000	-12.78	-6.24
Pre-test Experiment	7.36*	1.652	.000	4.11	10.65
	4.034*	1.652	.017	.77	7.31
	-5.468*	1.652	.002	-8.75	-2.21
Post-test Experiment	12.834*	1.652	.000	9.57	16.11
	9.501*	1.652	.000	6.24	12.78
	5.468*	1.652	.002	2.21	8.75

Pest results show Treffinger earning and traditional learning. With F = 0.116 is reached with a significance level of less than 0.05 based on the test of between-subjects effects, as displayed in Table 8. Thus, kids who study using the Treffinger and students who study conventionally have different learning outcomes.

Additionally, a comparison of the Treffinger model learning model and the traditional learning model is offered, along with an examination of the importance of the difference in the average score of learning outcomes. The Treffinger model and the traditional learning model's predicted mean score and standard deviation (SD) for student group learning outcomes are shown in Table 9 as follows:

The difference in the average learning outcome score has a standard deviation of 1.652 and a significance value of less than 0.05, as seen in Table 9 above. With typical learning models, the Treffinger average score differs significantly at a significance level of 0.05. The average Treffinger score is statistically higher than the average group learning outcomes score from the traditional learning model. Students who study using the

Treffinger model produce superior learning results than those who follow the traditional learning model.

According to the examination of the data, Treffinger is very successful at enhancing process skills and student learning outcomes. It is evident from the six core elements of the developed process skills that the types of process skills held by students who received practical instruction and those who received conventional instruction differ significantly. Students can practice this part of their process skills by using the syntax in the cooperative learning model of the Treffinger type.

If you look at the influence of the Treffinger learning model, it has shown changes in process skills such as communicating, concluding, and predicting compared to process skills in the control class, which reveals aspects of student understanding in the medium category. Conventional. It takes a process to teach students the process skills of communicating, concluding, and forecasting since the Treffinger syntax makes it highly possible to improve students' process abilities. Indicates that students build scientific attitudes through the development of process skills. Strong process skills are correlated with high learning outcomes.

Discussion

Based on the analysis in this study shows that the process skills and learning outcomes by the Treffinger model obtained an F count = 12.85 with a significance level of Pillai's Trace, Wilks' Lambda, Hotelling's and Roy's Largest Root less than 0.05, the value of F = 0.116 is obtained with a significance of less than 0.05. means that there is a significant difference in the average score of processing skills between groups of students who take part in learning using experiments and groups of students who take part in conventional learning.

The results of research by Ndiung et al., (2021) show that the Treffinger model is superior to traditional learning models in terms of learning outcomes and developing process skills skills. Condition is also in line with Zahra et al., (2021), who used a simple linear regression test and the N-Gain test to compare the effectiveness of the Treffinger model. The study results show a significant and influential influence in improving process skills skills based on Socio Scientific Issues. Ramadhan et al., (2021) used the t-test and the Mann-Whitney test. To measure extroverted and introverted personalities. The findings demonstrated that pupils' talents varied significantly.

Widiari et al. (2014) used a quasi-experimental with a post-test-only control group design to assess student learning outcomes taught using the mind-mapping learning method. The study's results showed significant and influential differences in improving students' thinking skills. Akhmad et al. (2021) conducted a quasi-experimental research design using the pre-test and post-test. The study's findings show that (despite the quasi-experimental research employing the experimental and control classes, there are substantial differences in learning outcomes between groups of students using mind-mapping learning and employing expository learning approaches. Ramadhan et al., (2021) also show differences in the process skills abilities of each student.

According to research by Zulkarnaen et al. (2021) the Treffinger model measures students' capacities for creative thinking. The study's findings demonstrate that while this approach is applied according to the anticipated syntax, students' creative thinking abilities still need to be added to their qualifications. The following Ramadhan et al. (2021) research development to develop learning tools with the Treffinger model assisted by the Geogebra application, and the results meet quite good categories with minor revisions according to the validator's suggestions so that these devices are feasible and can be used in the learning process (Hasanah, et al. 2022). Investigation of the theoretical implications of social reconstruction theory-based learning models that are pertinent in the context of social learning using the Treffinger model demonstrates that the Treffinger learning model has an impact on students' creative thinking.

Additionally, the application of the Treffinger STEM-based model to creative thinking skills, as well as elements that affect learning, have all been researched by many experts. Additionally, Lestari & Hadi, (2022) showed how well learning was implemented, how better creativity was fostered, how well teachers could explain the material, and how essential it was for students to have an active role in their education. Conducive. Ridhiyani et al. (2022) also reviewed the Treffinger-assisted worksheet model, which shows the influence and progress of each dimension of process skills ability and is added to the theory of constructively oriented learning.

CONCLUSION

In this study, an analysis was conducted on the effectiveness of the Treffinger method in enhancing students' process skills and learning outcomes in the field of science. The research results indicate that the Treffinger method has a significant positive impact on improving students' process skills and learning outcomes compared to conventional teaching methods. In the analysis of process skills, the Treffinger method has been proven to enhance students' abilities in observation, communication, grouping, measurement, conclusion, and prediction. The significant differences between the experimental and control groups consistently demonstrate that the Treffinger approach provides benefits in the development of students' process skills.

In the analysis of learning outcomes, students taught using the Treffinger method achieved higher average scores in learning assessments compared to the group receiving conventional instruction. These differences also hold strong levels of significance, indicating that the Treffinger method effectively enhances students' understanding and achievements. The utilization of various statistical tests such as MANOVA, descriptive analysis, and tests for normality and homogeneity adds strength to the analysis in this study. These findings strongly support the hypothesis that the Treffinger method has a positive and significant impact on students' process skills and learning outcomes.

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