International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

The Effect of Project-Based Learning Models and Learning Styles on Creative Thinking Skills of Students

Abdul Hamid B[1], Khoirul Efendiy[2] , Nia Wahyu Damayanti[3]
[1,2] Lecturer Wisnuwardhana University of Malang, Indonesia
[3]Lecturer of State University of Surabaya, Indonesia

ABSTRACT: The purposes of this study are: (1) to examine the effect of the Project-Based Learning model on the creative thinking skills of students, (2) to examine the effect of Learning Styles on the creative thinking skills of students, (3) to examine the effect of the interaction between Project-Based Learning and Learning Styles on creative thinking skills of students. The research design is quasi-experimental research. The subjects of this study are 22 students majoring in Mathematics Education at Wisnuwardhana University, and the instruments used are questionnaires and tests. The analysis technique used is two-way ANOVA (Analysis of Variance). The results of the study showed that there is an effect of the PjBL learning model on students' creative thinking skills because the calculated F value is 5.976 with a probability value or significance of 0.04 < 0.05. The hypothesis test results for the Learning Styles factor obtained a calculated F value of 34.012 with a probability value or significance of 0.03 < 0.05. This means that there is a significant difference in creative thinking skills among students with Visual, Auditory, and Kinesthetic learning styles. Additionally, there is an influence of the interaction between the Learning Model and Learning Styles on creative thinking skills because the calculated F value is 7.760 with a probability value or significance of 0.04 < 0.05.

KEYWORDS: Creative Thinking skills, Learning Styles, Project Based Learning.

INTRODUCTION

Developing creative abilities can lead students to become individuals capable of making decisions and problem-solving (Dwijananti & Yulianti, 2010). Critical thinking skills also serve as a means to achieve the educational goal of enabling students to solve high-level problems (Nasution, 2008). Creative thinking skills are crucial for developing other thinking abilities (Hassoubah, 2002). There is a significant relationship between critical thinking and creative thinking. In other words, critical and creative thinking have a mutual relationship in enhancing student achievement (Ülger, 2026; Ülger, 2018).

Creative thinking is the ability to generate new, original, and innovative ideas in thought. It involves the use of imagination, problem-solving, the development of new concepts, and the combination of unexpected ideas. Creative thinking is an individual's ability to analyze new information and combine ideas or concepts to solve a problem. Creative thinking is defined as a way to perceive and solve problems from a unique perspective and thinking outside the box (Gafour & Gafour, 2020). Creative thinking skills involve analyzing data and providing varied problem-solving responses.

Creative thinking needs to be developed in students because it not only helps them in solving learning problems but also facilitates achieving the established learning goals. Creative thinking ability has a very strong relationship with problem-solving skills. There are several benefits of creative thinking, namely: (1) generating new solutions to problems, (2) designing innovative ideas in product development, (3) obtaining satisfaction in producing work that is different from others, (4) developing creativity and imagination, (5) increasing confidence in expressing new ideas, (6) becoming a creative and innovative thinker who stands out from others, and (7) providing opportunities to try new challenging things and hone abilities. Therefore, a lecturer needs to build or develop creative thinking skills during the teaching and learning process. Using suitable methods is one approach to fostering creative thinking of students.

Building creative thinking skills is highly beneficial for students as it can contribute to their learning success. Students who possess both creative and critical thinking skills tend to achieve higher academic performance compared to those who do not possess these skills (Kusmawa, 2019; Wenno, 2021).

One of the instructional models believed to foster students' critical and creative thinking is the Project-based Learning (PjBL) model. PjBL is an approach to learning that emphasizes the modeling of a project which results in a product output. The findings reveal a significant enhancement in students' creative thinking abilities following instruction for both the experimental

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

group (n-gain = 0.47; $p < 0.05$) and the control group (n-gain = 0.25; $p < 0.05$). However, there was a notable divergence in creative thinking achievements between the experimental and control groups ($p < 0.05$). Consequently, it can be inferred that the Project-Based Learning (PjBL) model exerts a substantial impact on students' creative thinking skills (Biazus & Mahtari, 2022). Additionally, Ariyani et al. (2019) support this assertion by indicating the influence of the PjBL model on students' creative thinking skills.

The implementation of this model not only encourages students to collaborate in problem-solving resulting in a product but also stimulates and trains students' creative thinking. There is an impact of learning models on creative thinking abilities of students (Lestari, 2022; Putri & Zulyusri, 2022; Noviyana, 2017). There is also an effect of using a learning model on students' communication and creative thinking skills (Astuti, 2022). Similarly, there is a significant influence on students' critical thinking skills in terms of linking, comparing and contrasting, grouping, classifying, and analyzing (Nugroho, 2019).

Students who are taught using the PjBL (Project-based Learning) model have critical and creative thinking skills, collaboration, and communication skills compared to students taught conventionally (Alawi, 2019). Besides the learning model, another factor that can contribute to critical thinking, creativity, and learning outcomes is learning style. Learning style is a combination of how students absorb, organize, and process information. Learning style is the easiest way for individuals to absorb, organize, and process received information (Putri, 2022). Learning style influences students' learning achievement (Bire, 2014). Furthermore, learning style correlates with students' critical and creative thinking or there is a correlation or relationship between learning style and creative thinking (Fuad, 2020).

METHOD

a. Research Design

The research design utilized in this study is quasi-experimental research. Quasi-experimental research was chosen for the following reasons: (1) the researcher could not form pure experimental groups as existing classes had to be utilized. This means that there was no randomization of subjects into experimental or control groups, and (2) the characteristics of quasi-experimental research findings are more suitable for real-world learning implementation (Alkathiri, 2018). This study aims to investigate the influence of PjBL (Project-based Learning) and Learning Styles on students' creative thinking skills, as well as the interaction effect between the Learning Model and Learning Styles on creative thinking skills. Therefore, two groups were formed in this study: an experimental group and a control group. Thus, the research design employed in this study is a version of the non-randomized control group pretest-posttest design (Creswell, 2016), it is also known as the pretest-posttest nonequivalent factorialized control group design in a 2x2 factorial design version (Ary, 2002; Bruce, 1999).

b. Research Subjects

The subjects of this study are 22 students majoring in Mathematics Education at Wisnuwardhana University. Subject determination was conducted using a cluster random sampling technique. After performing cluster random sampling, a random sampling technique was then employed to determine the subjects who would receive treatment with PjBL and those who would receive treatment with PBL.

c. Research Instruments

The instruments used in this study are (1) the Learning Style Questionnaire, which is used to determine the learning styles of each research subject. (2) Tests. The tests to be conducted in this research are (a) Pre-test. The pre-test is conducted to assess the student's level of ability before being exposed to PjBL treatment, and (b) Post-test is to determine the impact of PjBL and learning styles on students' creative thinking skills.

d. Research Procedure

The research procedure for an experiment is a series of steps conducted by a researcher to test hypotheses and seek empirical evidence in a scientific study. The research procedure to be carried out is as follows: (1) determining the research subjects, (2) identifying the subjects' learning styles through filling out a learning style questionnaire, and (3) determining the experimental group and the control group. Conducting a pretest on both groups, (4) administering treatment to both groups, teaching the experimental group using PjBL and teaching the control group using PBL, and (5) conducting a posttest to assess the creative thinking skills of the students.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

e. Data Analysis Technique

In this study, which consists of two dependent variables, the analysis technique used is two-way ANOVA (Analysis of Variance). According to Tuckman (1999), ANOVA allows researchers to study the simultaneous effects of several independent variables, with the application having specific characteristics (two, three, or four). The use of factorial research design includes independent variables, moderator variables, and dependent variables, where the independent and dependent variables are referred to as factors. The hypothesis testing in the research is conducted through two stages, namely normality testing and hypothesis testing.

RESULT

The research findings involve tabulating the data obtained during the data collection stage and subjecting it to statistical analysis. This section presents three main aspects of the research findings: (1) Data Description; (2) Assumption Testing; and (3) Hypothesis Testing. The data description of the research pertains to a descriptive discussion of the research findings. Assumption testing and hypothesis testing encompass descriptions of the results of parametric assumption testing and hypothesis testing.

1. Data Description

In this section, the description of the research findings is presented based on the analysis results of the 15 research subjects. The data presented in this section relate to (1) learning style questionnaire results; (2) pre-test results from both groups (experimental group and control group); and (3) post-test results.

a. Description of Learning Style Questionnaire Data

From the learning style questionnaire results given to the students, it is evident that in the experimental group, there are 5 students with a Visual learning style, 3 students with an Auditory learning style, and 3 students with a Kinesthetic learning style. Meanwhile, in the control group, it is noted that there are 3 students with a Visual learning style, 4 students with an Auditory learning style, and 4 students with a Kinesthetic learning style. A detailed recapitulation of learning styles based on the questionnaire results can be seen in the following table:

Table 4.1. Research Sample Based on Learning Style Categories

Learning Style	Learning Model		Total
	PjBL	PBL	
Visual	5	3	8
Auditory	3	4	7
Kinesthetic	3	4	7
Total	11	11	22

Table 4.1 shows that 22 students are the research sample. Out of these 22 students, 8 students have a Visual learning style, 7 students have an Auditory learning style, and 7 students have a Kinesthetic learning style. In other words, Table 4.1 explains that students taught with the PjBL Learning Model amount to 11, with a breakdown of 5 students having a Visual learning style, 3 students with an Auditory learning style, and 3 students with a Kinesthetic learning style. Meanwhile, students taught with the PBL Learning Model total 11, comprising 3 students with a Visual learning style, 4 students with an Auditory learning style, and 4 students with a Kinesthetic learning style.

b. Description of Pre-test Data on Creative Thinking Skills

The pre-test conducted in both the treatment and control groups yielded data consisting of the initial abilities of each class, namely their creative thinking skills. Data on initial knowledge is necessary to determine whether there is a significant difference between the experimental and control groups. If the experimental and control groups do not show significant differences in initial abilities, it means that the research can proceed.

The description of pre-test data for the group of students treated with the Project-Based Learning (PjBL) model and the group of students treated with the Problem-Based Learning (PBL) model is analyzed using the statistical technique of an independent two-sample t-test. The calculation results using SPSS assistance can be seen in the following Table 4.2.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

Table 4.2 Pre-test Data of Creative Thinking Skills

Learning Models	N	Mean	Std. Deviation
PjBL	11	66.64	3.880
PBL	11	66.95	3.677

Table 4.2 explains that the group of 11 students taught with the PjBL Learning Model obtained a mean pre-test score of 66.64 with a standard deviation of 3.880. Meanwhile, the group of students taught with the PBL Learning Model, also consisting of 11 individuals, obtained a mean pre-test score of 66.95 with a standard deviation of 3.667. In other words, the mean score of the group taught with PjBL is higher than the group taught with the PBL Learning Model.

To determine the significant difference in pre-test results between the two treatment groups, it is necessary to conduct statistical analysis using an independent sample t-test. The results of the independent sample t-test analysis are presented in the following table.

Table 4.3. The analysis of the t-test (Independent Sample t-test)

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Pretest	Equal variances assumed	0.771	.390	-,197	128	.846

Table 4.3 explains that the calculation results of the pre-test value using the t-test show that the F-value for the pre-test results with Equal Variance Assumed t-test is 0.771 with a probability or significance level of 0.390. The t-value is -0.197 with df=128 at a significance level of 0.390. Since the t-value = -0.197 < t-table = 1.717, the null hypothesis (Ho) stating that there is no difference in comprehension of reading materials between students taught with the PjBL and the group taught with the PBL is accepted. Therefore, it can be concluded that there is no significant difference in the pretest results between the PjBL group and the PBL group.

c. Description of creative thinking skills post-test data

The post-test data of creative thinking skills from both groups of students who were treated with PjBL and groups of students who received treatment with PBL were analyzed using descriptive statistical calculations. The results of the post-test of creative thinking skills from students who received treatment with PjBL and students who received treatment with PBL can be seen in the following Table 4.4.

Table 4.4. Summary of Post-test Analysis Results of Creative Thinking Skills

Descriptive Statistics

Learning Models	Learning Styles	Mean	Std. Deviation	N
PjBL	Visual	91,10	1.516	5
	Auditory	83.50	1.500	3
	Kinesthetic	86.50	1,000	3
	Total	**87.77**	**3.559**	**11**
PBL	Visual	87.00	0.866	3
	Auditory	80,75	1,258	4
	Kinesthetic	83.62	1.108	4
	Total	**83.50**	**2.511**	**11**

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

Table 4.4 above, presents the results of the post-test data analysis, both post-test data from the PjBL group and post-test data from the group of students who received treatment with the PBL learning model. The data presented include the mean, standard deviation, and the number of students (N).

The post-test data on creative thinking skills for the group of students who received treatment with the PjBL learning model with Visual learning style obtained a mean of 91.10; SD (Standard Deviation) = 1.516; and N = 5, for students with Auditory learning style obtained a mean = 83.50; SD = 1.500, and N = 3. Meanwhile, students with Kinesthetic learning styles obtained a mean = 86.50, SD = 1.000, and N = 3. Overall, the post-test data on creative thinking for students who received treatment with the PjBL learning model, considering Visual, Auditory, and Kinesthetic learning styles, obtained a mean = 87.77; SD = 3.559, and N = 11.

The data on creative thinking skills for the group of students who received treatment with the PBL learning model with Visual learning style obtained a mean of 87.00; SD (Standard Deviation) = 0.866; and N=3. Students with an Auditory learning style obtained a mean = 80.75; SD = 1.258, and N = 4. Meanwhile, students with Kinesthetic learning styles obtained a mean = 83.62, SD = 1.108, and N = 4. The total number of data on creative thinking skills for students taught with the PBL learning model, including students with Visual, Auditory, and Kinesthetic learning styles, obtained a mean = 83.50; SD = 2.511, and N = 11.

2. Testing Assumptions

a. Normality Testing of Data

Normality testing is used to determine whether the sample taken comes from a normal distribution or not. In its testing, several procedures must be carried out to determine whether the sample taken originates from a normal distribution or not.

The normality test is conducted on data regarding creative thinking skills among groups of students based on: (1) PjBL (Project-based Learning) and PBL (Problem-based Learning) instructional models, and (2) Visual, Auditory, and Kinesthetic learning styles. In this normality testing, the Lilliefors Significance Correlation test from the Kolmogorov-Smirnov test is used with a significance level (α) of 0.05. The hypothesis tested in this case is the null hypothesis (Ho), which states that the research sample originates from a population with a normal distribution. Acceptance or rejection is based on: (1) if the significance or probability obtained > 0.05, then the sample comes from a population with a normal distribution, and (2) if the significance or probability value obtained < 0.05, then the sample does not come from a population with a normal distribution.

Results of normality testing for the post-test scores of student groups based on the Learning Model are presented in the Table below:

Table 4.5. Results of Normality Testing for Post-Test Data Based on Learning Models

	Leraning Models	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Creative Thinking Skills	PjBL	0,142	11	0.943	.943	11	.551
	PBL	0,133	11	0.970	.970	11	.884

*. This is a lower bound of the true significance

a. Lilliefors Significance Correction

The results of the Lilliefors Significance Correlation test from the Kolmogorov-Smirnov test reveal that: (1) the significance value of creative thinking skills from the group of students treated with the PjBL Learning Model is 0.943 > 0.05, and (2) the significance value of creative thinking skills from the group of students treated with the PBL Learning Model is 0.970 > 0.05. Hence, it can be concluded that the data on creative thinking skills, both from the group of students taught with the PjBL Learning Model and the group taught with the PBL Learning Model, are normally distributed.

Meanwhile, the results of the normality test for the post-test data based on students' learning styles (Auditory, Visual, and Kinesthetic) are shown in the following table.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

Table 4.6. Results of Normality Testing for Post-Test Data Based on Learning Styles

	Learning Styles	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Creative Thinking Skills	Auditory	0,159	7	0,200	0,948	7	0,711
	Visual	0,158	7	0,200	0,983	7	0,971
	Kinesthetic	0,132	7	0,200	0,970	7	0,895

*. This is a lower bound of the true significance
a. Lilliefors Significance Correction

The results of the Lilliefors Significance Correlation test from the Kolmogorov-Smirnov test indicate that: (1) the significance value for creative thinking based on the Auditory learning style is 0.200 > 0.05, (2) the significance value for creative thinking based on the Visual learning style is 0.200 > 0.05, and (3) the significance value for creative thinking based on the Kinesthetic learning style is 0.200 > 0.05. Therefore, it can be concluded that the data on creative thinking outcomes from students with Auditory, Visual, and Kinesthetic learning styles are normally distributed.

b. Data Homogeneity Testing

Homogeneity testing aims to determine whether several groups of research data have the same variance or not. In other words, homogeneity means that the dataset we are examining has similar characteristics. This homogeneity test is conducted on data concerning creative thinking skills in groups of students who received treatment with the PjBL Learning Model compared to groups of students who received treatment with the PBL Learning Model, including students with Auditory, Visual, or Kinesthetic learning styles, using the Levene's test at a significance level (α) of 0.05. The hypothesis tested in this case is the null hypothesis (Ho) which states that the variance in each group is the same (homogeneous). Acceptance or rejection is based on: (1) if the significance or probability obtained > 0.05, then the variance of each sample is the same (homogeneous), and (2) if the significance or probability obtained < 0.05, then the variance of each sample is not the same (non-homogeneous). The complete calculation results can be seen in the following table.

Table 4.7. Results of Homogeneity Testing for Creative Thinking Skills with Levene's Tests

Test of Homogeneity of Variance				
		Levene Statistic	df2	Sig.
Creative Thinking Skills	Based on Mean	1.346	20	.260

The homogeneity test table 4.7 above shows that based on the mean of creative thinking data, Levene's test yielded a value of 1.346; df2 = 20; and a significance level of 0.260. Since the significance level of 0.260 > 0.05, it can be concluded that the data on creative thinking skills is homogeneous.

3. Research Hypothesis Testing

Hypothesis testing is conducted on data regarding students' creative thinking skills, both those who received treatment with the PjBL Learning Model and those who received treatment with the PBL Learning Model. From these two groups, each consists of students with Auditory, Visual, and Kinesthetic learning styles. The purpose of hypothesis testing is to prove the validity of the proposed hypotheses. The hypotheses proposed are as follows: (1) There is a difference in creative thinking between students treated with the PjBL Learning Model and students treated with the PBL Learning Model; (2) There is a difference in creative thinking skills among students with Auditory, Visual, and Kinesthetic learning styles; and (3) There is an interaction effect between the Learning Model and students' learning styles on creative thinking skills.

The data analysis technique used in testing this hypothesis uses two-way analysis of variance, namely 2 x 2 factorial. Data was analyzed using the Statistical Package for Social Science (SPSS) computer software.

The results of testing the influence of variables individually are presented in the following table:

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

Table 4.8 Results of Testing the Influence of Variables Individually

Tests of Between-Subjects Effects

Dependent Variable: Creative Thinking Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	261,330(a)	17	15,372	14,906	,009
Intercept	136085,625	1	136085,625	131961,818	,000
Learning Models	80,115	13	6,163	5,976	,049
Learning Styles	70,150	2	35,075	34,012	,003
Learning Models * Learning Styles	16,006	2	8,003	7,760	,042
Error	4,125	4	1,031		
Total	161262,000	22			
Corrected Total	265,455	21			

a R Squared = ,984 (Adjusted R Squared = ,918)

Based on Table 4.8 above, it can be explained that:

a. Results of Analysis on Learning Models

Table 4.7 indicates that the 2x2 ANOVA test on creative thinking skills with the obtained F-value for the Learning Model variable is 5.976 with a probability value or significance of 0.04 < 0.05, thus rejecting the null hypothesis (Ho). This implies that there is a significant difference in creative thinking between students treated with the PjBL Learning Model and those treated with the PBL Learning Model. Therefore, it can be concluded that the hypothesis stating "There is a difference in creative thinking skills between students taught with the PjBL Learning Model and those taught with PBL" is accepted.

The difference in creative thinking between students taught with PjBL and those taught with PBL is also evident in the descriptive statistical analysis results. In Table 4.4, the descriptive statistical analysis results show a difference in the average score increase in creative thinking between those using PjBL and those using PBL. Students using PjBL obtained an average score increase from the pre-test to the post-test of 21.13, while students using PBL obtained an average score increase from the pre-test to the post-test of 16.55. The PjBL class obtained a higher average score than the PBL class (21.13 > 16.55). Thus, it can be concluded that lectures using PjBL can enhance creative thinking more effectively than those using PBL.

b. Results of Analysis on Learning Styles (Visual, Auditory, and Kinesthetic)

Based on Table 4.7, it can be observed that the computed F-value for students' learning styles is 34.012, with a probability value or significance level of 0.03 < 0.05. Consequently, the null hypothesis (Ho) is rejected. This implies that there is a significant difference in creative thinking among students with Visual, Auditory, and Kinesthetic learning styles. In other words, the hypothesis stating "There exists a difference in the level of creative thinking among students with Visual, Auditory, and Kinesthetic learning styles" is supported and accepted.

c. Results of Analysis on the Interaction Effect between Learning Models and Learning Styles

The computed F-value for the interaction between Learning Models and learning styles found in Table 4.8 is 7.760, with a probability value or significance level of 0.04 < 0.05. Therefore, the null hypothesis (Ho) stating that there is no interaction effect between Learning Models and learning styles is rejected. This indicates that there is indeed an interaction effect between Learning Models and learning styles on creative thinking skills.

DISCUSSION

Based on the results of hypothesis testing, there is a significant difference in creative thinking abilities between the group of students taught using the PjBL model and the group taught using the PBL model. Overall, the group of students treated with the PjBL model achieved higher mean results compared to the group of students treated with the PBL model. This is evidenced by the calculation results of the reading comprehension test, where students treated with PjBL obtained an average score of 87.77, while the group of students taught with the PBL model obtained an average score of 83.50. Thus, it can be concluded

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

that the implementation of the PjBL model has a better effect compared to the PBL model. The same goes for the results of hypothesis testing. The results of hypothesis testing for reading strategies show that the calculated F-value is 5.976 with a probability value or significance level of 0.042 < 0.05. It means that the learning model has a significant effect on students' creative thinking.

These research findings serve as a basis for further research that emphasizes the superiority of the PjBL model over the PBL model. In other words, the discussion will focus on the advantages of the PjBL model over the PBL model. Many previous research findings support these results, indicating that the PjBL (Project-Based Learning) model has a significant impact on creative thinking skills. Among them are research studies conducted by (Darmuki & Hidayati, 2023; Maquita & Tobeli,2022; Ananda et al., 2021; Rahayuningsih et al.,2022).

Darmuki & Hidayati (2023) conducted research by implementing PjBL to examine the influence of PjBL implementation on higher-order thinking. This study employed a classroom action research design through two cycles. Each cycle consisted of planning, implementation, observation, and reflection. The research results indicated that the implementation of the PjBL model can enhance students' higher-order thinking skills. The percentage of students' higher-order thinking skills, categorized as HOTS (Higher Order Thinking Skills), increased from 30% in the pre-cycle to 50% in cycle 1 and further to 88% in cycle 2. Similarly, for the creativity category, the percentage of students' creativity increased from 29% in the pre-cycle to 51% in cycle 1 and further to 90% in cycle 2. Based on the research findings, it can be concluded that the implementation of the PjBL model can enhance students' higher-order thinking skills.

Maquita & Tobeli (2022) conducted research by implementing the PjBL learning model. This study was quantitative research. The results showed that the correlation coefficient was 0.747 with a significance level of 0.01 < 0.05, indicating a strong relationship between the implementation of the PjBL learning model and students' creative thinking skills. The regression coefficient test results indicated the magnitude of the influence of the implementation of the PjBL learning model, which was 0.927 with a significance level of 0.00 < 0.05. Therefore, it can be concluded that the PjBL model influences students' creative thinking skills.

Ananda et al. (2021) researched to examine the impact of implementing PjBL on students' critical thinking and creative thinking skills in Physics learning. This study employed meta-analysis as its research methodology. Meta-analysis is a research method that involves summarizing, reviewing, and analyzing data from multiple studies that have been conducted. The re-sampled research consisted of 17 articles that already had ISSN numbers. The data analysis technique used in this study involved calculating the effect size for each article. Based on the research findings, it was found that the impact of implementing PjBL on students' critical thinking and creative thinking abilities can be concluded as follows: Firstly, the implementation of PjBL in twelfth-grade classes is more effective in enhancing students' critical thinking and creative thinking abilities compared to classes in tenth and eleventh grades, with an effect size of 2.51. Secondly, the implementation of PjBL on the topic of Electromagnetic Induction is more effective in enhancing students' critical thinking abilities, with an effect size of 2.51, while the implementation of PjBL on the topic of Sound Waves is more effective in enhancing students' creative thinking abilities, with an effect size of 3.43.

The ability to think creatively is one of the contributions of the learning styles possessed by each student. These learning styles represent the individual's way of absorbing, organizing, and processing information received. Alkhatiri et. al (2018) stated that there is a relationship between learning styles and creative thinking skills. Yulianci et al. (2020) add that learning styles involve a combination of ways individuals absorb, organize, and process information. Arumsari (2023) and Qomari et al. (2022) highlight the importance of recognizing students' learning styles as a key to success in the learning process. Mastuti et al. (2022) emphasize that learning that considers students' learning styles can enhance the quality of education. In certain contexts, learning styles can influence students' reflective thinking and problem-solving abilities (Titaley et al., 2021; Wulansari et al., 2019).

The implications of learning styles on creative thinking skills related to this research indicate that learning styles significantly influence the enhancement of creative thinking skills. This is evidenced by the post-test data analysis results, which show that students with Visual learning styles obtained an average score of 91.10 with a Standard Deviation of 1.516. Students with Auditory learning styles obtained an average score of 83.50 with a Standard Deviation of 1.500. Meanwhile, students with Kinesthetic learning styles obtained an average score of 86.50, with a Standard Deviation of 1.000. Based on these average scores, it can be concluded that students with Visual learning styles have higher creative thinking compared to those with Auditory and Kinesthetic learning styles.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

The analysis results showed that the significance level (sig.) of learning styles is 0.03 < 0.05, rejecting the null hypothesis (Ho) that states there is no difference in creative thinking skills among students with Visual, Auditory, and Kinesthetic learning styles and accepting the research hypothesis that there is a significant difference in creative thinking abilities among students with Visual, Auditory, and Kinesthetic learning styles. This is supported by the findings of Kassim (2013), which show a relationship between learning styles and the improvement of creative thinking. These results are due to the alignment of the use of the PjBL learning model with students' learning styles. Other research also indicates the influence of learning styles on creative thinking. In other words, if the learning model applied considers or adapts to students' learning styles, the understanding of creative thinking skills increases, especially in receiving, thinking, processing, and storing information, problem-solving, and making learning activities more active and enjoyable.

The results of the analysis of the interaction effect between variables reveal a phenomenon where the influence of one variable on another is not only direct but also influenced by a third variable called a moderator variable. Interaction refers to the collaboration of two or more independent variables in influencing a dependent variable (Kerlinger, 2004). Ghozali (2011) states that the interaction effect is the joint effect of two or more independent variables on the dependent variable. Hair et al. (2010) suggest that interaction occurs when independent variables do not have separate and individual effects. Conversely, interaction does not occur if more than one independent variable has separate significant effects. The effects of the independent variables are called main effects.

In this context, Marwiyah et al. (2020) explain that when there is interaction between the learning model and the moderator variable, the main effects of the independent variable and the moderator variable on the dependent variable can weaken the existing interaction.

Based on Table 4.8, the results of comparing the average creative skills based on the interaction between the treatment groups of the learning model (PjBL and PBL) and learning styles (Visual, Auditory, and Kinesthetic) were obtained. The hypothesis testing results using ANOVA indicate an F-value of 7.760 with a significance level of 0.04 smaller than 0.05 (0.04 < 0.05), thus rejecting the null hypothesis (Ho) that there is no interaction effect between the learning model and learning styles on creative thinking. It can be concluded that the learning model is also influenced by learning styles in enhancing creative thinking. In other words, the improvement in creative thinking abilities is not solely due to the implementation of the learning model but also influenced by students' learning styles.

Theoretically, the findings of this research support the opinions of several experts. For instance, the research by Kusumantyas et al. (2020) indicates that the PjBL model significantly affects creative thinking (sig = 0.000; p < 0.05). The mean value of students' creative thinking abilities in PjBL ($\bar{x}$ = 87.33) is higher than the mean in the discovery learning class ($\bar{x}$ = 75.17). Other learning models such as Make A Match, SAVI (Somatic, Auditory, Visualization, Intellectual), and Problem-Based Learning (PBL) have also been shown to impact students' creative thinking abilities (Faradhillah et al., 2022; Erpidawati & Putri, 2022; Sari et al., 2023). These learning models provide diverse approaches yet remain effective in enhancing students' creative thinking skills.

PjBL (Project Based Learning) has been proven to have a significant impact on improving students' creative thinking skills. Various studies have been conducted to evaluate the effect of PjBL on creative thinking skills. For example, research has shown that the implementation of the PjBL learning model significantly affects the improvement of students' creative thinking skills in Grade Seventh (Maquita & Tobeli, 2022). Additionally, research confirms that PjBL contributes to improving students' critical and creative thinking skills in Physics learning (Ananda et al., 2021).

The research results indicate that students' creative thinking abilities, as assessed by visual learning styles, are more likely to meet the indicators of originality and elaboration. Meanwhile, students' creative thinking abilities, as assessed by auditory learning styles, tend to fulfill the indicators of originality and elaboration. Furthermore, students' creative thinking abilities, as assessed by kinesthetic learning styles, tend to fulfill the indicator of originality (Rizqi, 2023).

Based on these research findings, it can be concluded that both PjBL and PBL learning models influence students' creative thinking abilities. Similarly, the learning styles possessed by each student can contribute to the level of creative thinking skills. Thus, all evidence from these studies strongly supports the findings of this research, indicating an interaction effect between the learning models (PjBL and PBL) and learning styles on students' creative thinking skills.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 04 April 2024
DOI: 10.47191/ijcsrr/V7-i4-24, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

CONCLUSION

Based on the analysis of posttest data on creative thinking in the group of students treated with the PjBL Learning Model with the Visual learning style, a mean of 91.10 was obtained, SD (Standard Deviation) = 1.516, and N = 5. For students with the Auditory learning style, the mean was 83.50, SD = 1.500, and N = 3. Meanwhile, for students with the Kinesthetic learning style, the mean was 86.50, SD = 1.000, and N = 3. Regarding the posttest data on creative thinking skills in the group of students treated with the PBL Learning Model, it is known that students with the Visual learning style obtained a mean of 87.00, SD (Standard Deviation) = 0.866, and N = 3. For students with the Auditory learning style, the mean was 80.75, SD = 1.258, and N = 4. While students with the Kinesthetic learning style obtained a mean of 83.62, SD = 1.108, and N = 4.

The result of the analysis of creative thinking skills obtained an F-value of 5.976 with a probability or significance value of 0.04 < 0.05. This means that there is a significant difference in creative thinking between students treated with the PjBL Learning Model and those treated with the PBL Learning Model. Descriptive statistical analysis results show a difference in the average score increase in creative thinking. Students using PjBL had an average score increase from the pretest to the posttest of 21.13, while students using PBL had an average score increase of 16.55. The PjJBL class obtained a higher average score than the PBL class (21.13>16.55).

The result of the analysis of the Learning Style factor (Visual, Auditory, and Kinesthetic) shows that the F-value of students' learning styles is 34.012 with a probability or significance value of 0.03 < 0.05. This means that the creative thinking skills of students with Visual, Auditory, and Kinesthetic learning styles are significantly different. Meanwhile, the result of the analysis of the interaction effect between variables shows that the F-value is 7.760 with a probability or significance value of 0.04 < 0.05. This means that there is an interaction effect between the Learning Model and learning styles on creative thinking skills.

REFERENCES

1. Alkathiri,F., Alshreef1, S., Alajmi, S., Alsowayan, A. & Alahmad, N. 2018. A Systematic Review: The Relationship between Learning Styles and Creative Thinking Skills. *English Language and Literature Studies*, Vol. 8 (1), 34-44. http://doi.org/10.5539/ells.v8n1p34
2. Ariyani,E., Jalmo, T., Yolida, B. 2019. The Influence of the PjBL Model on Students' Science Communication Skills and Creative Thinking. *Jurnal Bioterdidik Wahana Ekspresi Ilmiah*,Vol. 7 (3), 1-12. https://jurnal.fkip.unila.ac.id/index.php/JBT/article/view/17318/pdf
3. Biazus, M. de O., & Mahtari, S. 2022. The Impact of Project-Based Learning (PjBL) Model on Secondary Students' Creative Thinking Skills. *International Journal of Essential Competencies in Education*, Vol. 1(1), 38-48. https://doi.org/10.36312/ijece.v1i1.752
4. Gafour , O.W.A & Gafour, W.A.S. 2020. *Creative Thinking skills-A Review Article*. https://www.researchgate.net/publication/349003763
5. Hassoubah ZI. 2002. Mengasah Pikiran Kreatif dan Kritis. Jakarta: Nuansa.
6. Kassim, H. 2013. The Relationship between Learning Styles, Creative Thinking Performance and Multimedia Learning Materials. Procedia-Social and Behavioral Sciences, Vol. 97 (.), 229-237. https://doi.org/10.1016/j.sbspro.2013.10.227
7. Kidder, L. 1981. Research Methods in Social Relation. Holt: Rinehart and Winston
8. Kusmawan W, Turmudi T, Juandi D, Sugilar H. 2018. Enhancing Creative Thinking and Mathematical Problem-Solving Skills of Madrasah Aliyah Students . *Jurnal Analisa*, Vol. 4 (1), 33-42. https://doi.org/10.15575/ja.v4i1.2839.
9. Kusumaningtyas, Sikumbang, D., Hasnunidah, N. 2020. The Influence of Project Based Learning (PjBL) Model on Students' Creative Thinking Abilities. *Jurnal Bioterdidik: Wahana Ekspresi Ilmiah*. Vol. 8 (2), 11-19 https://jurnal.fkip.unila.ac.id/index.php/JBT/article/view/20920/14719
10. Lestari I, Ilhami A. 2022. The Implementation of a Model to Enhance Students' Creative Thinking Skills: Systematic Review. *LENSA (Lentera Sains) Jurnal Pendidikan IPA*, Vol.12 (2), 135-144. http://jurnallensa.web.id/index.php/lensa
11. Maquita, S. & Tobeli, E. 2022. The Implementation of Project Based Learning Model to Enhance Creative Thinking Skills of 7th Grade Students in Christian Religious Education Class. *Jurnal Sosial Humaniora dan Pendidikan*,Vol.1 (1), 88–95. https://doi.org/10.56127/jushpen.v1i1.286

12. Mastuti, A.G, Abdillah, Maya Rumodar,M. 2022. Improving the Quality of Teacher Instruction Through Workshops and Differentiated Instruction Mentorship. *JMM (Jurnal Masyarakat Mandiri)*, Vol. 6 (5), 3415-3425. https://doi.org/10.31764/jmm.v6i5.9682
13. Nasution. 2008. *Berbagai Pendekatan dalam Proses Belajar Mengajar*. Jakarta: Bumi Aksara
14. Nazir, M. 2009. Metode Penelitian. Jakarta: Ghalia Indonesia
15. Noviyana H. 2017. The Influence of Project Based Learning Model on Students' Mathematical Creative Thinking Abilities. *Jurnal Edumath* , Vol. 3 (2),110-117. http://ejournal.stkipmpringsewu-lpg.ac.id/index.php/edumath
16. Nugroho, A.T., Jalmo, T., Surbakti, A. 2019. "The Effect of Project Based Learning Model on Science Communication Skills and Creative Thinking". *Jurnal Bioterdidik*, Vol. 7 (3),50-58. https://jurnal.fkip.unila.ac.id/index.php/JBT/article/view/17428
17. Putri R.K, Bukit N, Simanjuntak MP. The Effect of Model's on Critical Thinking Skills, Creative Thinking Skills, Collaboration Skills, & Communication Skills (4C) Physics in Senior High School. Proc. 6th Annu. Int. Semin. Transform. Educ. Educ. Leadersh. (AISTEEL 2021), vol. 591, 2022. https://doi.org/10.2991/assehr.k.211110.103.
18. Putri, Y.A & Zulyusri. 2022. Meta-Analysis of the Effect of Project Based Learning Model on Students' Creative Thinking Ability in Biology Learning. *Bioeduca: Journal of Biology Education*, Vol. Vol. 4 (2)2), 1-11. https://www.semanticscholar.org/reader/32063f9036476f1d93dbdef15a6adb77d0b5cc05
19. Qomari; Nor,M. ; Lestari; Ayu, S.; Nur, F.. 2022. Learning Trajectory in Differentiated Instruction of Perimeter of Plane Figures Based on Learning Styles Differences. *DIDAKTIKA: Jurnal Pemikiran Pendidikan*, Vol. 28 (2), 29-41, http://dx.doi.org/10.30587/didaktika.v28i2(1).4399
20. Rizqi, M. 2023. Mathematical Creative Thinking Ability in Relation to Learning Styles in Problem-Based Learning with Macromedia Flash Assistance. *Jurnal Matematika Thales (JMT)*, Vol. 05 (02), 2-16. https://jurnal.ugm.ac.id/jmt/issue/view/5326/showToc
21. Sari, T. N., Sukarno, S., & Irawan, T. A. 2023. The Influence of Problem Based Learning Model on Critical Thinking Skills and Problem-Solving Abilities of 10th Grade Students at SMAN 36 Musi Banyuasin. *Physics and Science Education Journal (PSEJ)*, Vol. 2 (3), 148-152. https://doi.org/10.30631/psej.v2i3.1656
22. Sugiyono. 2021. Metode Penelitian Kuantitatif Kualitatif dan R&D. Bandung: Alfabeta
23. Titaley, C.R., Taihuttu, Y., Bension, J., Iwan, R.F., Ruray, I.D. 2021. Medical Students' Knowledge at Pattimura University Faculty of Medicine Regarding Their Learning Styles and Its Relationship with Their Academic Achievement in the First Year. *Molucca Medica*, Vol.14 (2), 141-152. https://doi.org/10.30598/molmed.2021.v14.i2.141
24. Tuckman, B.W. 1999. *Conducting Educational Research, Fifth Edition*. New York: Harcourt Brace Collage Publisher
25. Ulger, K. (2018). The Effect of Problem-Based Learning on the Creative Thinking and Critical Thinking Disposition of Students in Visual Arts Education. *Interdisciplinary Journal of Problem-Based Learning*, Vol.12 (1). https://doi.org/10.7771/1541-5015.1649.
26. Ülger K. 2016. The Relationship between Creative Thinking and Critical Thinking Skills of Students. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi* (*H. U. Journal of Education*) Vol. 31(4): 695-710. https://doi.org/10.16986/huje.2016018493.
27. Wenno IH, Jamaludin J, Batlolona, JR. 2021. The Effect of Model on Creative and Critical Thinking Skills in Static Fluid Topics. *Jurnal Pendidik Sains Indonesia*. https://doi.org/10.24815/jpsi.v9i3.20829.
28. Wulansari, MD., Purnomo,D., Utam, R.E. 2019. Analysis of Eighth Grade Students' Reflective Thinking Abilities in Solving Mathematical Problems: A Review Based on Visual and Auditory Learning Styles. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, Vol. 1 (6), 393-402. https://doi.org/10.26877/imajiner.v1i6.4869
29. Yulianci, S., Nurjumiati, N., & Asriyadin, A. 2020. Analysis of the Characteristics of Students' VAK (Visual, Auditory, Kinesthetic) Learning Styles in Physics Learning. *Jurnal Pendidikan MIPA*, 10(1), 40-44. https://doi.org/10.37630/jpm.v10i1.328

Cite this Article: Abdul Hamid B , Khoirul Efendiy, Nia Wahyu Damayanti (2024). The Effect of Project-Based Learning Models and Learning Styles on Creative Thinking Skills of Students. International Journal of Current Science Research and Review, 7(4), 2192-2202