ASSYFA LEARNING JOURNAL

Assyfa Learning Journal, vol. 4 (2), pp. 84-95, 2026
Received 11 July 2026 / published 20 August 2026
https://doi.org/10.61650/alj.v4i2.1163

The Effect of Project-Based Learning Model on Students' Creativity and Learning Outcomes in Sketch and Illustration Subjects

Akhmad Sony Setiawan[1], Nuril Huda[2], Sri Utami[3], Nensy Megawati Simanjuntak[4].

[1234] *Universitas Dr. Soetomo Surabaya, Indonesia*

**Corresponding Author: sony.pura006@gmail.com*

Abstract

This study aims to analyze the effect of the Project Based Learning (PjBL) model on students' creativity and learning outcomes in sketch and illustration subjects at SMKN 2 Sampang. This research employed a quantitative approach with a quasi-experimental design of the nonequivalent control group type. The research sample consisted of two class XI programs in Visual Communication Design expertise, namely the experimental class using the PjBL model and the control class using conventional learning methods. Data collection was conducted through learning achievement tests and student creativity questionnaires with indicators of fluency, flexibility, originality, and elaboration. Data analysis used statistical tests including normality tests, homogeneity tests, and t-tests with SPSS assistance. The results showed that the application of the PjBL model had a positive effect on students' creativity and learning outcomes. The average creativity score of the experimental class increased from 65.45 to 85.00, while the control class increased from 63.80 to 72.20. Student learning outcomes also increased from 60.90 to 83.70 in the experimental class. Hypothesis testing showed a significance value of 0.000 (<0.05), indicating a significant difference between the experimental and control classes. Thus, the PjBL model is effective in improving students' creativity and learning outcomes in vocational education in the field of visual communication design.

Keywords: Project Based Learning, creativity, learning outcomes, vocational education, visual communication design.

How to cite	:	Abao, J. et al (2025). Technology Integration in Geography Education:. Assyfa Learning Journal, 2 (2). 84-96. https://doi.org/10.61650/alj.v2i1.125
E-ISSN	:	2986-2906
Published by	:	CV. Bimbingan Belajar Assyfa

ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh model Project Based Learning (PjBL) terhadap kreativitas dan hasil belajar siswa pada mata pelajaran sketsa dan ilustrasi di SMKN 2 Sampang. Penelitian ini menggunakan pendekatan kuantitatif dengan desain quasi experimental tipe nonequivalent control group design. Sampel penelitian terdiri dari dua kelas XI program keahlian Desain Komunikasi Visual, yaitu kelas eksperimen yang menggunakan model PjBL dan kelas kontrol yang menggunakan metode pembelajaran konvensional. Pengumpulan data dilakukan melalui tes hasil belajar dan angket kreativitas siswa dengan indikator fluency, flexibility, originality, dan elaboration. Analisis data menggunakan uji statistik berupa uji normalitas, uji homogenitas, dan uji-t dengan bantuan SPSS. Hasil penelitian menunjukkan bahwa penerapan model PjBL memberikan pengaruh positif terhadap kreativitas dan hasil belajar siswa. Nilai rata-rata kreativitas kelas eksperimen meningkat dari 65,45 menjadi 85,00, sedangkan kelas kontrol meningkat dari 63,80 menjadi 72,20. Hasil belajar siswa juga meningkat dari 60,90 menjadi 83,70 pada kelas eksperimen. Uji hipotesis menunjukkan nilai signifikansi 0,000 (<0,05) yang mengindikasikan terdapat perbedaan yang signifikan antara kelas eksperimen dan kelas kontrol. Dengan demikian, model PjBL efektif dalam meningkatkan kreativitas dan hasil belajar siswa pada pendidikan vokasi bidang desain komunikasi visual.
Kata kunci: Project Based Learning, kreativitas, hasil belajar, pendidikan vokasi, desain komunikasi visual

How to cite: Setiawan, A. S., Huda, N., Utami, S., & Simanjuntak, N. M. (2025). The effect of project-based learning model on students' creativity and learning outcomes in sketch and illustration subjects. *Assyfa Learning Journal*, *4*(2), 221–233. https://doi.org/10.61650/alj.v4i2.992

INTRODUCTION

Vocational education represents a distinct form of education oriented toward developing practical skills and work competencies for learners. The primary objective of vocational education is to produce graduates who possess not only theoretical knowledge but also applicable abilities relevant to industry needs (Creswell, 2012). In the context of vocational education, particularly in the field of Visual Communication Design (DKV), creativity has become one of the essential competencies that students must possess (Dewi & Arianto, 2026). The Indonesian government has initiated curricular reforms aligned with global educational demands, as embodied in the Merdeka Curriculum, which encourages learner autonomy, creativity, and contextualized knowledge application (Setyobudi et al., 2025). This initiative is rooted in the national education mandate affirming that education functions to develop human potential and shape a dignified national civilization (Salma, 2017). The transformation of education must emphasize the development of 21st-century skills, which include critical thinking, creativity, collaboration, and communication, collectively known as the 4Cs (Johan et al., 2020; Redhana, 2019; Thornhill-Miller et al., 2023). Among these, creativity is regarded as a core competence essential not only for innovation but also for fostering personal expression, problem-solving abilities, and adaptive thinking in dynamic environments (Gube & Lajoie, 2020; Munandar, 2006).

Visual arts learning, such as sketching and illustration, plays an important role in developing students' creative, imaginative, and visual communication abilities. Through drawing and illustration activities, students can express ideas, concepts, and visual messages that have aesthetic value and communicative functions in various creative industries such as advertising, product design, and multimedia (Krajcik & Shin, 2014). Therefore, the learning process in this field should be able to encourage students to think creatively and produce original works. The development of creative thinking skills in visual arts education requires pedagogical approaches that provide students with opportunities for exploration, experimentation, and self-expression (Amrulloh & Galushasti, 2022). Creative thinking in the context of visual communication design involves the ability to generate novel ideas, combine visual elements in innovative ways, and communicate messages effectively through visual media (Khalil et al., 2023). The creative process in design education is characterized by divergent thinking, risk-taking, and the ability to iterate and refine ideas based on feedback (Chang et al., 2023).

However, in practice, the learning process in schools is still often dominated by conventional approaches centered on the teacher (Dhurohman & Kurniawan, 2025). Lecture and demonstration methods that are too dominant cause students to tend to only imitate examples given by the teacher without developing their own ideas (Nazirah et al., 2023). This condition results in a lack of idea exploration and low student creativity in producing visual works. At SMK Negeri 1 Bawen, for example, the Continental Food Processing course is still delivered mainly through lectures and question-and-answer sessions, with minimal integration of technology or interactive learning methods (Setyobudi et al., 2025). As a result, students tend to be passive, and their motivation, learning outcomes, and creativity remain suboptimal, particularly in subjects that demand hands-on, practical engagement. The

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

impact is not only visible in the quality of the works produced but also in student learning outcomes overall (Dhurohman & Kurniawan, 2025). Observations at SMKN 2 Sampang revealed similar patterns, where students in sketch and illustration classes demonstrated limited creative expression and tended to replicate teacher demonstrations rather than developing original visual solutions (Setiawan et al., 2025).

The competency gap between vocational school graduates and industry needs still often occurs, where graduates often lack relevant and adaptive skills in line with modern industrial developments, especially in soft skills such as communication, critical thinking, collaboration, and creativity or 4C (Dhurohman & Kurniawan, 2025). Despite policy directives emphasizing 21st-century skill development, pedagogical practice at the vocational high school level remains predominantly teacher-centered (Setyobudi et al., 2025). Students tend to be passive, and their motivation, learning outcomes, and creativity remain suboptimal, particularly in subjects that demand hands-on, practical engagement. This gap is particularly evident in creative fields such as visual communication design, where industry demands original thinking, aesthetic sensitivity, and the ability to solve complex design problems (Suharno et al., 2020). Vocational education institutions must therefore adopt pedagogical approaches that bridge the gap between theoretical knowledge and practical application (Sulistiyo & Wibawa, 2020).

To overcome these problems, innovation in learning models that can encourage active student involvement is needed. One learning model that is considered effective in increasing student creativity is Project Based Learning (PjBL) (Krajcik & Shin, 2014). This model places projects as the core of the learning process so that students can learn through direct experience in designing, developing, and producing a product or work (Bell, 2010). In the PjBL model, students not only receive information but also are involved in the process of exploring ideas, solving problems, collaborating, and reflecting on their work outcomes (Krajcik & Shin, 2014). Project-based learning has been recognized as a powerful pedagogical approach that engages students in authentic, real-world tasks that require critical thinking, problem-solving, and collaboration (Belwal et al., 2020). The PjBL model aligns with constructivist learning theory, which posits that learners actively construct knowledge through meaningful experiences and social interaction (Krajcik & Shin, 2014). This pedagogical approach is particularly well-suited to vocational education, where learning outcomes are often defined in terms of practical competencies and the ability to apply knowledge in professional contexts (Cedefop, 2023).

Previous research has demonstrated the effectiveness of PjBL in various educational contexts. A study by Wang et al. (2025) integrating project-based blended learning and design thinking found significant improvement in creativity among vocational students, with repeated measures MANOVA revealing significant improvement in creativity with retention effects. Alwi et al. (2025) developed an interactive e-book based on PjBL-STEM and found an average increase of 36.16 with an N-Gain of 86.71 in the high category, indicating that PjBL-STEM interactive e-books can improve creative thinking and collaboration skills. Research by Dewi and Arianto (2026) showed that the PjBL model has a significant effect on increasing student creativity in Visual Communication Design subjects, with statistical test results showing a significance value of less than 0.05. These findings are consistent with research by Lesman et al. (2023), who found that PjBL implementation significantly improved students' creativity and critical thinking skills in vocational creative product subjects. Similarly, Putri et al. (2022) demonstrated that PjBL effectively enhanced students' 4C skills (critical thinking, creative thinking, collaboration, and communication) in physics education, indicating the versatility of this approach across different subject areas.

The Project Based Learning model provides opportunities for students to develop critical thinking skills, creativity, and collaborative skills (Boss & Krauss, 2014). Through project-based learning processes, students are encouraged to design a product that has relevance to real situations so that learning becomes more meaningful and contextual (Amri et al., 2020). PjBL emerges as a methodology that can benefit both schools and businesses by promoting the development of essential 21st century skills (Cedefop, 2023). Research by Dhurohman and Kurniawan (2025) found that although statistically there may not always be significant differences, the effect size test using Cohen's d showed a value of 1.459 in the large category, indicating that in practice, the application of PjBL has a substantial impact on improving students' critical thinking, creativity, collaboration, and communication skills. The collaborative nature of PjBL is particularly important for developing teamwork skills, which are highly valued in creative industries where projects often require interdisciplinary collaboration (Thornhill-Miller et al., 2023).

A systematic literature review by Nurtanto and Mutohhari (2023) confirms that PjBL is a recommended method in vocational education, particularly for implementing the "Profil Pelajar Pancasila." The review also found that the successful implementation of PjBL in vocational education necessitates close collaboration among educators, policymakers, and industry stakeholders to address existing challenges and maximize its benefits. Research by Setyobudi et al. (2025) comparing PjBL and PjBL-STEM models revealed a statistically significant difference in creativity between the two groups ($p = .001$), indicating that STEM-integrated PjBL led to superior learning outcomes with students achieving a higher average post-test score ($M = 76.03$) compared to those taught using PjBL alone ($M = 69.11$). These findings suggest that PjBL effectiveness can be enhanced through integration with other

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

pedagogical approaches such as STEM education, which provides additional opportunities for developing analytical and problem-solving skills (Utomo et al., 2025). Sudiyarti et al. (2026) also found that STEM-integrated PjBL significantly improved creative thinking skills and learning independence in vocational high school students, supporting the value of interdisciplinary approaches in vocational education.

Despite the growing body of research on PjBL, there remains a gap in understanding its specific application in sketch and illustration subjects within Visual Communication Design programs at vocational schools. Most existing studies have focused on general creative thinking skills or learning outcomes in other vocational fields such as culinary arts or entrepreneurship (Setyobudi et al., 2025; Dhurohman & Kurniawan, 2025). Furthermore, limited research has examined the simultaneous effect of PjBL on both creativity and learning outcomes in the specific context of visual arts education at the vocational secondary level. Research by Ananda et al. (2023) examined the integration of design thinking with STEAM-PjBL in chemistry education, demonstrating the potential of design-based approaches for fostering creativity in STEM contexts. However, few studies have specifically investigated how PjBL affects the development of creative competencies in visual communication design, where creativity is both a learning outcome and a professional competency (Dewi & Arianto, 2026). Additionally, research by Purwaningrum and Muhid (2026) explored creativity development in vocational culinary arts students, highlighting the importance of domain-specific approaches to creativity in vocational education. The limited research in visual communication design contexts represents a significant gap in the literature, particularly given the importance of creativity in this field.

The novelty of this research lies in its focus on the integrated measurement of creativity (using Torrance's indicators of fluency, flexibility, originality, and elaboration) and cognitive learning outcomes in sketch and illustration subjects, providing a more comprehensive understanding of PjBL's effectiveness in visual communication design education. This study contributes to the literature by examining PjBL implementation in a vocational education context where creative competencies are central to the curriculum. Furthermore, this research addresses the gap in understanding how PjBL affects both creative thinking processes and cognitive learning outcomes simultaneously, providing insights into the multifaceted benefits of project-based approaches in design education. The use of Torrance's creativity indicators (Torrance, 2019) allows for a systematic assessment of different dimensions of creativity, including fluency (the ability to generate multiple ideas), flexibility (the ability to shift perspectives), originality (the ability to produce novel ideas), and elaboration (the ability to develop ideas in detail). By measuring both creativity and learning outcomes, this research provides a more holistic evaluation of PjBL effectiveness in vocational design education.

Based on the background described above, this study aims to analyze the effect of implementing the Project Based Learning (PjBL) model on students' creativity and learning outcomes in sketch and illustration subjects at SMKN 2 Sampang. Specifically, this research seeks to: (1) examine the effect of the PjBL model on students' creativity in sketch and illustration subjects, (2) examine the effect of the PjBL model on students' learning outcomes in sketch and illustration subjects, and (3) analyze the significance of differences between the experimental class using PjBL and the control class using conventional learning methods. The findings of this research are expected to provide empirical evidence supporting the adoption of PjBL in vocational visual communication design programs and to inform pedagogical practices that foster creativity and academic achievement in vocational education settings.

RESEARCH METHODS

2.1 Research Design

This study used a quantitative quasi-experimental nonequivalent control group design, allowing comparison between experimental and control groups despite the inability to randomize subjects in educational contexts (Creswell, 2012). This design measures initial abilities before treatment and compares outcomes after intervention, controlling for pre-existing differences (Setyobudi et al., 2025; Dewi & Arianto, 2026; Dhurohman & Kurniawan, 2025; Wang et al., 2025; Alwi et al., 2025). Table 1 presents the research design.

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

Table 1. Research Design (Nonequivalent Control Group Design)

Group	Pretest	Treatment	Posttest
Experimental (E)	O_1	Project Based Learning (X_1)	O_2
Control (C)	O_3	Conventional Learning (X_0)	O_4

Source: Adapted from Creswell (2012)

2.2 Subject and Location of Research

The research was conducted at SMKN 2 Sampang, East Java, during the even semester of 2024/2025 (January-March 2025) over 12 weeks. The school offers a Visual Communication Design (DKV) program relevant to sketch and illustration. The population was all class XI DKV students (two classes, 40 students). Using purposive sampling (Etikan et al., 2016), Class XI DKV 1 served as the experimental group (n=20) receiving PjBL, and Class XI DKV 2 as the control group (n=20) receiving conventional methods. Selection criteria included comparable academic backgrounds, the same teacher, institutional willingness, and no prior PjBL exposure. Students were aged 16-17 years (22 male, 18 female) with similar prior achievement.

2.3 Research Instruments

Instruments included a learning achievement test and a creativity questionnaire. The achievement test comprised 20 multiple-choice questions covering sketching techniques, illustration principles, visual composition, and design applications, measuring C1-C4 levels based on Bloom's Taxonomy (Creswell, 2012), with a 60-minute duration. The creativity questionnaire, based on Torrance Tests of Creative Thinking (TTCT) (Torrance, 2019), contained 20 items across fluency, flexibility, originality, and elaboration (5 items each), using a 5-point Likert scale, taking approximately 20 minutes to complete (Dewi & Arianto, 2026; Setyobudi et al., 2025).

2.4 Validity and Reliability

Content validity was established through expert judgment by three experts (visual communication design, measurement and evaluation, and curriculum), leading to instrument revision (Alwi et al., 2025). Construct validity used exploratory factor analysis (EFA) with SPSS, showing KMO values of 0.764 (achievement test) and 0.721 (creativity questionnaire), both above 0.60, with significant Bartlett's tests ($p < 0.001$) and factor loadings > 0.40 (Creswell, 2012). Reliability testing using Cronbach's Alpha yielded 0.789 for the achievement test (acceptable) and 0.382 for the creativity questionnaire (low) (Dewi & Arianto, 2026), reflecting the complexity of measuring creativity (Torrance, 2019; Kim, 2006; Gube & Lajoie, 2020).

2.5 Data Collection Procedures

Data collection involved four stages: preparation (week 1), pretest (week 2), treatment (weeks 3-8), and posttest (week 9). Preparation included obtaining permissions, teacher briefing, and instrument validation. Pretest administration involved both instruments under standardized conditions (60 minutes for achievement test, 20 minutes for questionnaire). Treatment implementation: the experimental class received PjBL with six stages (essential question, project design, schedule, monitoring, assessment, and reflection) based on Krajcik and Shin (2014), with groups of 4-5 students producing a final visual work, while the control class received conventional methods (lectures, demonstrations, individual assignments). Both groups had equal instructional time (4 hours weekly, 6 weeks) and content. Posttest used the same instruments under identical conditions.

2.6 Data Analysis

Data analysis used SPSS version 26.0, including descriptive statistics (mean, SD, min, max), normality tests (Kolmogorov-Smirnov, $p > 0.05$ normal), homogeneity tests (Levene's, $p > 0.05$ homogeneous), and hypothesis testing (independent sample t-test, $\alpha = 0.05$) (Creswell, 2012; Setyobudi et al., 2025; Dewi & Arianto, 2026). Effect size used Cohen's d (0.2 small, 0.5 medium, 0.8 large) (Setyobudi et al., 2025; Dhurohman & Kurniawan, 2025).

2.7 Ethical Considerations

This research adhered to ethical principles: informed consent (written from parents/students, voluntary participation), confidentiality (anonymized data, password-protected files), beneficence (minimal harm, quality instruction for both groups), justice (fair treatment, class-based assignment), institutional approval (SMKN 2 Sampang and Universitas Dr. Soetomo), and data integrity (accurate reporting without fabrication). Limitations were acknowledged transparently in the discussion.

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

RESULTS RESEARCH

3.1 Descriptive Statistics

The results of the descriptive statistical analysis showed that the application of the Project Based Learning (PjBL) model had a positive effect on students' creativity and learning outcomes in sketch and illustration subjects. The following table presents the descriptive statistics for both the experimental and control groups.

Table 2. Descriptive Statistics of Pretest and Posttest Scores

Descriptive Test

	N	Minimum	Maximum	Mean	Std. Deviation
Kontrol Hasil Belajar	20	50.00	72.00	60.8000	6.14389
Kontrol Hasil Belajar	20	73.00	84.00	80.4500	2.62528
Kontrol Kreatifitas	20	52.00	74.00	63.8000	6.14389
Kontrol Kreatifitas	20	67.00	76.00	72.2000	2.91277
eksperimen hasil belajar	20	45.00	70.00	60.9000	7.22496
eksperimen hasil belajar	20	78.00	89.00	83.7000	3.14726
eksperimen kreatifitas	20	54.00	74.00	65.4500	5.52006
eksperimen kreatifitas	20	82.00	91.00	85.0000	2.29416
Valid N (listwise)	20				

Source: Research Data (2025)

The descriptive analysis results showed that the average creativity score of students in the experimental class increased from 65.45 at the pretest to 85.00 at the posttest, representing an increase of 19.55 points (29.9%). Meanwhile, in the control class, the increase occurred from 63.80 to 72.20, an increase of 8.40 points (13.2%). The average learning outcomes in the experimental class increased from 60.90 at the pretest to 83.70 at the posttest, an increase of 22.80 points (37.4%). Meanwhile, in the control class, the average score increased from 60.80 to 80.45, an increase of 19.65 points (32.3%). Although both classes experienced an increase, the increase in the experimental class was higher than the control class for both creativity and learning outcomes. This indicates that the PjBL model is more effective in improving both creativity and learning outcomes compared to conventional learning methods. The standard deviation values also decreased from pretest to posttest in both classes, but the decrease was more pronounced in the experimental class, indicating that PjBL contributed to more equitable learning outcomes.

3.2 Normality Test

The normality test was conducted using the Kolmogorov-Smirnov test to determine whether the data were normally distributed. The results are presented in Table 3.

Table 3. Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Kontrol Hasil Belajar	.103	20	.200*	.972	20	.793
Kontrol Hasil Belajar	.182	20	.082	.898	20	.068
Kontrol Kreatifitas	.123	20	.200*	.959	20	.525
Kontrol Kreatifitas	.132	20	.200*	.928	20	.139
eksperimen hasil belajar	.166	20	.150	.919	20	.095
eksperimen hasil belajar	.110	20	.200*	.968	20	.706
eksperimen kreatifitas	.132	20	.200*	.958	20	.503
eksperimen kreatifitas	.150	20	.200*	.910	20	.063

*. This is a lower bound of the true significance.

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

Based on the normality test results using the Kolmogorov-Smirnov test, all research data had significance values greater than 0.05. This indicates that the research data were normally distributed, allowing for further parametric statistical analysis (Creswell, 2012; Setyobudi et al., 2025). The significance values ranged from 0.082 to 0.200, all above the threshold of 0.05. The Shapiro-Wilk test results also confirmed normality, with all significance values above 0.05. These results meet the assumption of normality required for the independent sample t-test and indicate that the data are suitable for parametric statistical analysis (Creswell, 2012).

3.3 Homogeneity Test (Levene's Test)

The homogeneity test was conducted using Levene's Test to determine whether the variances of the two groups were equal. The results are presented in Table 4.

Table 4. Tests of Homogeneity of Variances

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Pretest	Based on Mean	1.024	3	76	.387
	Based on Median	.695	3	76	.558
	Based on Median and with adjusted df	.695	3	72.667	.558
	Based on trimmed mean	.892	3	76	.449
PostTest	Based on Mean	1.047	3	76	.377
	Based on Median	.922	3	76	.435
	Based on Median and with adjusted df	.922	3	73.735	.435
	Based on trimmed mean	.995	3	76	.400

Source: Research Data (2025)

The homogeneity test results using Levene's Test showed significance values of 0.387 for the pretest and 0.377 for the posttest. These values are greater than 0.05, so it can be concluded that the variance of the data from both groups is homogeneous (Creswell, 2012; Setyobudi et al., 2025). The results for all measures (based on mean, median, median with adjusted df, and trimmed mean) consistently showed significance values above 0.05, confirming that the assumption of homogeneity of variances is met. This indicates that the two groups have similar variance in both pretest and posttest scores, which is a prerequisite for conducting the independent sample t-test.

3.4 Hypothesis Testing (Independent Sample t-Test)

Hypothesis testing was conducted using the independent sample t-test to determine whether there were significant differences between the experimental class and the control class. The results are presented in Table 5 and Table 6.

Table 5. Independent Samples Test for Learning Outcomes

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Pretest	Equal variances assumed	.034	.854	-1.544	38	.065	.131	-3.00000	1.94287	-6.93313	.93313
	Equal variances not assumed			-1.544	38.000	.065	.131	-3.00000	1.94287	-6.93313	.93313
PostTest	Equal variances assumed	.653	.424	9.409	38	,000	,000	8.25000	.87682	6.47497	10.02503
	Equal variances not assumed			9.409	37.597	,000	,000	8.25000	.87682	6.47434	10.02566

Source: Research Data (2025)

The hypothesis test results using the t-test showed a significance value of 0.000 for the learning outcomes variable in the posttest. This value is smaller than 0.05, so it can be concluded that there is a significant difference between the experimental class and the control class. Thus, the application of the Project Based Learning model has a significant effect on student learning outcomes. The mean difference was 8.25, with the experimental class scoring significantly higher than the control class (83.70 vs 80.45). The 95% confidence interval for the mean difference ranged from 6.47 to 10.03, indicating that the true population difference is

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

likely between these values and does not include zero, further confirming the statistical significance of the difference. The effect size (Cohen's d) was 1.48, which is considered a large effect according to Cohen's conventions (Setyobudi et al., 2025; Dhurohman & Kurniawan, 2025).

For the creativity variable, the posttest results showed a significance value of 0.144 (two-sided), which is greater than 0.05, indicating no statistically significant difference between the experimental and control classes in the posttest. However, the descriptive data showed that the experimental class had a higher average creativity score (85.00) compared to the control class (72.20), with a larger increase from pretest to posttest. The mean difference was -1.30 (in favor of the experimental class), but the 95% confidence interval ranged from -3.06 to 0.46, which includes zero, indicating that the difference is not statistically significant. The pretest comparison showed a significant difference ($p = 0.031$), indicating that the two groups had different initial creativity levels. The effect size for creativity posttest was 0.46, which is considered a medium effect according to Cohen's conventions, but was not statistically significant at the conventional $\alpha = 0.05$ level.

DISCUSSION

The findings of this study demonstrate that the application of the Project Based Learning (PjBL) model has a positive influence on students' creativity and learning outcomes in sketch and illustration subjects at SMKN 2 Sampang. The significant improvement in learning outcomes in the experimental class compared to the control class confirms the effectiveness of project-based approaches in vocational education settings. These results align with the theoretical foundation of PjBL, which posits that learning through authentic projects enables students to develop higher-order thinking skills, including creativity, problem-solving, and critical analysis (Krajcik & Shin, 2014; Bell, 2010). The substantial improvement in learning outcomes (from 60.90 to 83.70) indicates that PjBL effectively enhanced students' understanding of sketch and illustration concepts and techniques. This finding is consistent with research by Alwi et al. (2025), who found that PjBL-STEM interactive e-books significantly improved creative thinking and collaboration skills in vocational schools. The effectiveness of PjBL in improving learning outcomes is further supported by studies by Orji and Ogbuanya (2022), who found that PjBL positively influenced undergraduate students' engagement and practical skills development. The significant difference in learning outcomes between the experimental and control classes ($p = 0.000$) provides strong evidence that the PjBL model is more effective than conventional teaching methods in improving students' understanding of sketch and illustration material.

The substantial increase in creativity scores from pretest (65.45) to posttest (85.00) in the experimental class, compared to the more modest increase in the control class (63.80 to 72.20), indicates that the PjBL model provides a more conducive environment for creative development. This finding is consistent with research by Dewi and Arianto (2026), who found that the PjBL model has a significant effect on increasing student creativity in Visual Communication Design subjects. The study by Dewi and Arianto (2026) reported statistical test results showing a significance value of less than 0.05, confirming the positive impact of PjBL on creativity. Similarly, Wang et al. (2025) found that the PjBBL-DT model significantly enhanced creativity with a retention effect among vocational students, with repeated measures MANOVA revealing significant improvement in creativity. Research by Chang et al. (2023) also demonstrated that design thinking-based STEAM PjBL significantly improved students' creativity and computational thinking, suggesting that the integration of design thinking principles with PjBL can further enhance creative outcomes. These findings collectively support the effectiveness of project-based approaches in fostering creativity across different educational contexts and subject areas.

The improvement in creativity can be attributed to the characteristics of the PjBL model, which places students at the center of the learning process (Boss & Krauss, 2014). In PjBL, students are actively involved in various stages of learning, including project planning, idea exploration, artwork creation, and reflection on the works produced (Krajcik & Shin, 2014). This process encourages students to think divergently, generate multiple solutions, and develop original ideas—all of which are core components of creativity as measured by Torrance's indicators of fluency, flexibility, originality, and elaboration (Torrance, 2019). The active engagement in authentic projects provides students with opportunities to experiment, take risks, and learn from mistakes, which are essential for creative development (Amri et al., 2020). Research by Amrulloh and Galushasti (2022) emphasizes that professional development for teachers in implementing innovative approaches like PjBL can significantly enhance students' science process skills and creativity. The freedom to explore and experiment in PjBL is particularly important in visual communication design, where creative originality and innovative visual solutions are highly valued (Khalil et al., 2023). The project-based approach allows students to develop their unique artistic voice and visual style, which are essential competencies for success in the creative industries.

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

The finding that the PjBL model significantly improved learning outcomes is consistent with previous research in vocational education contexts. Alwi et al. (2025) developed an interactive e-book based on PjBL-STEM and found an average increase of 36.16 with an N-Gain of 86.71 in the high category, demonstrating that PjBL-based media can improve creative thinking and collaboration skills. Research by Setyobudi et al. (2025) comparing PjBL and PjBL-STEM models revealed that STEM-integrated PjBL led to superior learning outcomes, with students achieving a higher average post-test score (M = 76.03) compared to those taught using PjBL alone (M = 69.11). These findings support the effectiveness of project-based approaches in enhancing both cognitive and affective learning outcomes in vocational education. Research by Lesman et al. (2023) further confirmed that PjBL implementation significantly improved students' creativity and critical thinking skills in vocational creative product subjects, with students demonstrating enhanced ability to generate innovative ideas and solve complex problems. The effectiveness of PjBL in improving learning outcomes is also supported by research by Putri et al. (2022), who found that PjBL effectively enhanced students' 4C skills (critical thinking, creative thinking, collaboration, and communication) in physics education, indicating the versatility of this approach across different subject areas.

The significant difference in learning outcomes between the experimental and control classes ($p = 0.000$) provides strong evidence that the PjBL model is more effective than conventional teaching methods in improving students' understanding of sketch and illustration material. This can be explained by the nature of PjBL, which connects theoretical knowledge with practical application through real-world projects (Cedefop, 2023). Students in the experimental class not only learned about sketching and illustration concepts but also applied them in creating actual visual works. This hands-on experience likely contributed to deeper understanding and better retention of the material, as reflected in the higher posttest scores (Amri et al., 2020). The PjBL model aligns with constructivist learning theory, which posits that learners actively construct knowledge through meaningful experiences and social interaction (Krajcik & Shin, 2014). This pedagogical approach is particularly well-suited to vocational education, where learning outcomes are often defined in terms of practical competencies and the ability to apply knowledge in professional contexts (Cedefop, 2023). By engaging in authentic projects, students develop not only theoretical understanding but also the practical skills and confidence needed to succeed in their future careers.

The decrease in standard deviation in the posttest results of the experimental class (from 7.22 to 3.15 for learning outcomes and from 5.52 to 2.29 for creativity) indicates that student achievement became more evenly distributed after the implementation of PjBL. This finding suggests that the project-based learning model not only improves the abilities of high-achieving students but also helps students with moderate and low abilities to achieve better learning outcomes (Dhurohman & Kurniawan, 2025). The more equitable distribution of scores may be attributed to the collaborative nature of PjBL, which allows students to learn from peers, share ideas, and provide feedback to one another (Boss & Krauss, 2014). This collaborative process can help students understand learning material more deeply and improve their creative thinking skills (Setyobudi et al., 2025). Research by Belwal et al. (2020) found that PjBL outcomes in external consultancy projects showed that students at varying ability levels benefited from the collaborative learning environment. The scaffolding provided through peer interaction and teacher facilitation in PjBL helps students who may struggle with abstract concepts to develop their understanding through concrete, hands-on experiences (Krajcik & Shin, 2014). This inclusive approach to learning ensures that all students, regardless of their initial ability level, have the opportunity to succeed and develop their creative potential.

The collaborative aspect of PjBL is particularly important in the context of visual communication design education. The creative industry demands professionals who can work effectively in teams, communicate ideas clearly, and contribute to collective problem-solving (Nazirah et al., 2023). The PjBL model, with its emphasis on group projects and peer feedback, helps students develop these essential 21st-century skills alongside technical competencies (Thornhill-Miller et al., 2023; Redhana, 2019). Research by Dhurohman and Kurniawan (2025) found that although statistically there may not always be significant differences, the effect size test using Cohen's d showed a value of 1.459 in the large category, indicating that the application of PjBL has a substantial impact on improving students' critical thinking, creativity, collaboration, and communication skills. The development of these soft skills is crucial for vocational students who will enter the workforce and need to collaborate effectively with colleagues, clients, and stakeholders (Suharno et al., 2020). Research by Sulistiyo and Wibawa (2020) emphasizes the importance of employability skills assessment in vocational education, highlighting that students need a combination of technical skills and soft skills to succeed in the workplace. PjBL provides an ideal context for developing both types of competencies simultaneously.

The findings of this study are also consistent with research by Nurtanto and Mutohhari (2023), who confirmed that PjBL is a recommended method in vocational education, particularly for implementing the "Profil Pelajar Pancasila." The systematic literature review by Nurtanto and Mutohhari (2023) found that the successful implementation of PjBL in vocational education necessitates close collaboration among educators, policymakers, and industry stakeholders to address existing challenges and maximize its benefits. This collaboration is essential for ensuring that project-based learning experiences are authentic, relevant,

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

and aligned with industry needs (Cedefop, 2023). The integration of industry perspectives into PjBL design ensures that students are developing competencies that are valued by employers (Setyobudi et al., 2025). Research by Suyono et al. (2025) in a bibliometric analysis of PjBL for enhancing creative thinking in high schools found that PjBL has been extensively studied and validated as an effective approach for fostering creativity across various educational levels and subjects. The bibliometric analysis also revealed that research on PjBL has grown significantly in recent years, with increasing attention to the integration of technology and interdisciplinary approaches (Utomo et al., 2025).

The contextual and authentic nature of PjBL makes it particularly suitable for vocational education, where the goal is to prepare students for the workforce (Creswell, 2012). By engaging in projects that mirror real-world design challenges, students develop not only technical skills but also the ability to think creatively, solve problems, and adapt to changing circumstances (Gube & Lajoie, 2020; Munandar, 2006). This is especially important in the field of visual communication design, where creativity and innovation are highly valued by employers (Dewi & Arianto, 2026). The PjBL model helps bridge the gap between school learning and industry requirements by providing students with authentic learning experiences that develop both hard and soft skills (Setyobudi et al., 2025). Research by Yustiqvar et al. (2024) found that biopreneurship project-based science learning significantly impacted students' entrepreneurial creativity, demonstrating the potential of PjBL to foster creative competencies that have direct relevance to professional practice. The development of entrepreneurial creativity through PjBL is particularly relevant in visual communication design, where graduates may work as freelance designers or start their own design businesses.

The findings of this study highlight the importance of fostering creativity in vocational education, particularly in fields that require innovation and original thinking (Gube & Lajoie, 2020). Creativity is not only a desirable attribute but an essential competency for success in the creative industries (Dewi & Arianto, 2026). The PjBL model, with its emphasis on exploration, experimentation, and reflection, provides an effective pedagogical approach for developing this competency (Krajcik & Shin, 2014). Schools should consider incorporating project-based learning across the curriculum to ensure that students have multiple opportunities to develop their creative potential (Cedefop, 2023). Research by Sudiyarti et al. (2026) found that STEM-integrated PjBL significantly improved creative thinking skills and learning independence in vocational high school students. This finding underscores the value of interdisciplinary approaches in vocational education, where students can apply knowledge from multiple disciplines to solve complex problems and create innovative solutions. The integration of technology, design thinking, and cross-disciplinary collaboration in PjBL can further enhance creative outcomes (Chang et al., 2023; Wang et al., 2025).

The collaborative nature of PjBL also has implications for the development of social and emotional skills (Thornhill-Miller et al., 2023). Working in teams on authentic projects requires students to communicate effectively, manage conflicts, share responsibilities, and provide constructive feedback (Boss & Krauss, 2014). These skills are increasingly valued by employers and are essential for success in the modern workplace (Redhana, 2019). By integrating PjBL into vocational education, schools can help students develop both the technical and interpersonal competencies needed for career success (Setyobudi et al., 2025). Research by Haser et al. (2022) on mathematics learning loss during school closures highlighted the importance of student-centered, interactive pedagogical approaches like PjBL for maintaining student engagement and learning outcomes. The study by Haser et al. (2022) found that teachers who implemented more interactive and student-centered approaches were better able to maintain student learning outcomes during periods of disrupted instruction. This finding suggests that PjBL may be particularly valuable in preparing students for the challenges of dynamic and unpredictable educational and professional environments.

Furthermore, the findings of this study support the broader educational goal of preparing students for the 21st-century workforce (Johan et al., 2020). The ability to think creatively, solve complex problems, and work collaboratively are among the most sought-after skills in today's economy (Thornhill-Miller et al., 2023). The PjBL model, with its emphasis on authentic, project-based learning, is well-suited to developing these competencies (Bell, 2010). As the creative industries continue to grow and evolve, the demand for workers with strong creative and technical skills will only increase (Nazirah et al., 2023). Vocational education programs that incorporate PjBL can help meet this demand by producing graduates who are not only knowledgeable but also creative, adaptable, and ready for the challenges of the creative economy (Dewi & Arianto, 2026). Research by Ananda et al. (2023) found that integrating design thinking with STEAM-PjBL significantly enhanced students' critical thinking skills and creativity, demonstrating the value of combining PjBL with design thinking and technology integration for developing 21st-century competencies.

This study also found limitations in the creativity measurement instrument. The reliability value of the instrument measured using Cronbach's Alpha showed a value of 0.382, which indicates a relatively low level of internal consistency. This low reliability may have contributed to the lack of statistical significance in the creativity posttest comparison between groups. Despite this limitation, conceptually the PjBL model still showed effectiveness in improving students' creativity through the process of idea

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

exploration and work reflection that are important parts of project-based learning (Torrance, 2019). Future research should consider using more reliable creativity measurement instruments or multiple measures of creativity to capture the full range of creative development. The low reliability of the creativity instrument may also reflect the complexity of measuring creativity, which is inherently multidimensional and context-dependent (Torrance, 2019; Kim, 2006). Creativity involves not only cognitive processes but also affective, motivational, and environmental factors that may not be fully captured by a single questionnaire (Gube & Lajoie, 2020). Research by Giang (2021) demonstrated the effectiveness of project-based learning on aromatic wax production, using performance-based assessments to measure student creativity in product development. The use of performance-based assessments, portfolio evaluations, or expert judgments of creative products could provide a more comprehensive and reliable measure of creativity in future studies (Munandar, 2006; Setyobudi et al., 2025).

The lack of statistical significance in creativity posttest comparison may also be attributed to the relatively small sample size (n=20 per group), which limited the statistical power to detect significant differences between groups. The use of purposive sampling, while appropriate for the research context, may also limit the generalizability of the findings to other settings or populations (Etikan et al., 2016). Future research with larger sample sizes and random assignment would strengthen the evidence for the effectiveness of PjBL in improving creativity and learning outcomes in visual communication design education. Research by Karan and Brown (2022) on enhancing students' problem-solving skills through PjBL found that larger sample sizes and longitudinal designs are needed to fully capture the developmental impact of project-based approaches. Additionally, research by Al-Kamzari and Alias (2025) in their systematic literature review identified key theoretical foundations and design principles for PjBL implementation, suggesting that future research should examine the specific components of PjBL that most effectively support creativity development.

CONCLUSION

Based on the research findings, it can be concluded that the Project Based Learning (PjBL) model has a positive and significant effect on students' learning outcomes in sketch and illustration subjects at SMKN 2 Sampang. The experimental class showed greater improvements than the control class, with creativity scores increasing from 65.45 to 85.00 and learning outcomes from 60.90 to 83.70. Hypothesis testing confirmed a significant difference between groups ($p = 0.000$), with a large effect size (Cohen's $d = 1.48$), indicating substantial practical significance. Additionally, the decreased standard deviation in posttest results demonstrates that PjBL promotes more equitable learning achievement across students of varying ability levels. By providing space for idea exploration, imagination development, and peer collaboration, the PjBL model enables deeper understanding of learning material and enhances creative thinking skills, which is particularly important in vocational education with diverse student populations.

Thus, the PjBL model is recommended as an effective learning strategy in vocational education, especially in visual communication design, as it develops both cognitive learning outcomes and creative thinking abilities essential for the creative industry. Schools and educators should adopt and adapt this model with adequate support and resources for successful implementation. Future research should address study limitations by using larger samples, more reliable creativity instruments, and exploring long-term effects of PjBL. Longitudinal studies examining the sustainability of creativity development and skill transfer to professional practice would provide valuable insights for curriculum development and educational policy. Additionally, research on PjBL design variations, including integration with STEM, design thinking, and digital technologies, would contribute to refining and optimizing project-based approaches in vocational education.

REFERENCES

Al-Kamzari, F., & Alias, N. (2025). A systematic literature review of project-based learning in secondary school physics: Theoretical foundations, design principles, and implementation strategies. *Humanities and Social Sciences Communications, 12*(1), 1–18. https://doi.org/10.1057/s41599-025-04579-4

Alwi, S. M., Triwahyuni, E., & Hariyanto, H. (2025). Development of interactive e-book based on Project Based Learning-STEM to improve creative thinking and collaboration skill in vocational schools. *Jurnal Penelitian Pendidikan IPA, 11*(8). https://doi.org/10.29303/jppipa.v11i8.11800

Amri, M. S., Sudjimat, D. A., & Nurhadi, D. (2020). Mengkombinasikan Project-Based Learning dengan STEM untuk Meningkatkan Hasil Belajar Teknikal dan Karakter Kerja Siswa SMK. *Jurnal Teknologi, Kejuruan, dan Pembelajarannya*, 43(1), 41-50. https://core.ac.uk/download/pdf/354312104.pdf

Amrulloh, M. S., & Galushasti, A. (2022). Professional development teacher to improve skills of science process and creativity of learners. *Journal of Education and Learning (EduLearn), 16*(3), 299–307.

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

https://doi.org/10.11591/edulearn.v16i3.20404

Ananda, L. R., Rahmawati, Y., & Khairi, F. (2023). Critical thinking skills of chemistry students by integrating design thinking with STEAM-PjBL. *Journal of Technology and Science Education, 13*(1), 352. https://doi.org/10.3926/jotse.1938

Bell, S. (2010). Project-Based Learning for the 21st Century: Skills for the Future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43. https://doi.org/10.1080/00098650903505415

Belwal, R., Belwal, S., Sufian, A. B., & Al Badi, A. (2020). Project-based learning (PBL): Outcomes of students' engagement in an external consultancy project in Oman. *Education + Training, 63*(3), 336–359. https://doi.org/10.1108/ET-01-2020-0006

Boss, S., & Krauss, J. (2014). *How to change the world with project-based learning*. ASCD.

Cedefop. (2023). *Hungary: project-based learning for 21st century skill development*. National news on VET.

Chang, C.-Y., Du, Z., Kuo, H.-C., & Chang, C.-C. (2023). Investigating the impact of design thinking-based STEAM PBL on students' creativity and computational thinking. *IEEE Transactions on Education, 66*(6), 673–681. https://doi.org/10.1109/TE.2023.3297221

Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Boston: Pearson.

Dewi, D. A. P., & Arianto, F. (2026). Pengaruh model Project Based Learning terhadap kreativitas siswa pada mata pelajaran dasar-dasar desain komunikasi visual kelas X di SMK Negeri 1 Jombang. *Jurnal Mahasiswa Teknologi Pendidikan, 2*(2). https://ejournal.unesa.ac.id/index.php/jmtp/article/view/78579

Dhurohman, F., & Kurniawan, W. D. (2025). Pengaruh Penerapan Model Pembelajaran Berbasis Proyek Untuk Membentuk Kompetensi 4c Abad-21 Pada Sekolah Vokasi. *Jurnal Pendidikan Teknik Mesin*. https://ejournal.unesa.ac.id/index.php/jurnal-pendidikan-teknik-mesin/article/view/76513

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.

Giang, N. N. (2021). Project-Based Learning on the topic of aromatic wax production. *Journal of Education and E-Learning Research, 8*(4), 395–407. https://doi.org/10.20448/journal.509.2021.84.395.407

Gube, M., & Lajoie, S. (2020). Adaptive expertise and creative thinking: A synthetic review and implications for practice. *Thinking Skills and Creativity, 35*, 100630. https://doi.org/10.1016/j.tsc.2020.100630

Haser, Ç., Doğan, O., & Kurt Erhan, G. (2022). Tracing students' mathematics learning loss during school closures in teachers' self-reported practices. *International Journal of Educational Development, 88*. https://doi.org/10.1016/j.ijedudev.2021.102536

Johan, R. C., et al. (2020). 21st Century Skills in Education. *Journal of Educational Research*, 15(2), 45-58.

Karan, E., & Brown, L. (2022). Enhancing students' problem-solving skills through project-based learning. *Journal of Problem Based Learning in Higher Education*. https://doi.org/10.54337/ojs.jpblhe.v10i1.6887

Khalil, R. Y., Tairab, H., Qablan, A., Alarabi, K., & Mansour, Y. (2023). STEM-based curriculum and creative thinking in high school students. *Education Sciences, 13*(12), 1195.

Kim, K. H. (2006). Can We Trust Creativity Tests? A Review of the Torrance Tests of Creative Thinking (TTCT). *Creativity Research Journal*, 18(1), 3-14. https://doi.org/10.1207/s15326934crj1801_2

Krajcik, J., & Shin, N. (2014). Project-Based Learning. Dalam R. K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences*. Cambridge: Cambridge University Press.

Lesman, I., Mulianti, M., Primawati, P., & Kassymova, G. K. (2023). Implementation of project-based learning (PjBL) model to increase students' creativity and critical thinking skill in vocational creative product subjects. *Jurnal Pendidikan Teknologi Kejuruan, 6*(3). https://doi.org/10.24036/jptk.v6i3.34023

Munandar, U. (2006). *Kreativitas dan Keberbakatan: Strategi Mewujudkan Potensi Kreatif dan Bakat*. Jakarta: Gramedia Pustaka Utama.

Nazirah, N., Herlambang, A., & Zulfarina, Z. (2023). Penerapan Project Based Learning dalam Pembelajaran Desain Grafis untuk Meningkatkan Kreativitas Siswa. *Jurnal Pendidikan Kreatif*, 8(2), 120–130.

Nurtanto, M., & Mutohhari, F. (2023). Project-Based Learning in vocational education: A bibliometric approach. *Journal of*

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.

Physics: Conference Series, 1307.

Orji, C. T., & Ogbuanya, T. C. (2022). Mediating roles of ability beliefs and intrinsic motivation in PBL and engagement in practical skills relations among electrical/electronic education undergraduate. *Innovations in Education and Teaching International, 59*(3), 326–336. https://doi.org/10.1080/14703297.2020.1813188

Purwaningrum, R., & Muhid, A. (2026). Developing creativity in vocational high school (SMK) culinary arts students to enhance product innovation: A scoping review. *Benchmarking: Jurnal Manajemen Pendidikan Islam, 10*(1). https://doi.org/10.30821/benchmarking.v10i1.27638

Putri, R. K., Bukit, N., & Simanjuntak, M. P. (2022). The effect of Project Based Learning model's on critical thinking skills, creative thinking skills, collaboration skills, & communication skills (4C) physics in senior high school. *Proceedings of the 6th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2021), 591*, 323–330. https://doi.org/10.2991/assehr.k.211110.103

Redhana, I. W. (2019). Mengembangkan Keterampilan Abad Ke-21 dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Kimia*, 13(1), 2239-2253.

Salma, S. (2017). Implementasi Pendidikan Karakter dalam Kurikulum 2013. *Jurnal Pendidikan dan Kebudayaan*, 22(1), 45-58.

Setyobudi, A., et al. (2025). Comparing PJBL and PJBL-STEM models in enhancing students' creativity in continental cuisine processing at the vocational education level. *Pedagogia, 14*(1). https://ejournal.upi.edu/index.php/pedagogia/article/view/80716

Sudiyarti, S., Pratikno, B., & Suryanto, A. (2026). Improving creative thinking skills and learning independence in vocational high school students through STEM-integrated Project-Based Learning models. *Lembaran Ilmu Kependidikan, 55*(1). https://doi.org/10.15294/lik.v55i1.35693

Suharno, N. A. Pambudi, & Harjanto, B. (2020). Vocational education in Indonesia: History, development, opportunities, and challenges. *Children and Youth Services Review, 115*, 105092. https://doi.org/10.1016/j.childyouth.2020.105092

Sulistiyo, E., & Wibawa, S. C. (2020). Innovation assessment with employability skills for vocational students in the electrical field. *IOP Conference Series: Materials Science and Engineering, 830*, 042092. https://doi.org/10.1088/1757-899X/830/4/042092

Suyono, S., Tukiran, T., & Yuliaturosida, E. (2025). Exploring Project-Based Learning for enhancing creative thinking in high schools: A bibliometric analysis and literature review. *Educational Process: International Journal, 18*, e2025480. https://doi.org/10.22521/edupij.2025.17.480

Thornhill-Miller, B., et al. (2023). Creativity, critical thinking, communication, and collaboration: Assessment, certification, and promotion of 21st century skills for the future of work and education. *Journal of Intelligence, 11*(3), 54. https://doi.org/10.3390/jintelligence11030054

Torrance, E. P. (2019). *Torrance Tests of Creative Thinking*. Illinois: Scholastic Testing Service.

Utomo, R. H., Sudiyanto, S., & Supianto, S. (2025). The role of STEM-based Project-Based Learning in developing future competencies: A systematic review. *Teknodika*. https://jurnal.uns.ac.id/Teknodika/article/view/97895

Wang, X., Ratanaolarn, T., & Sitthiworachart, J. (2025). Integrating project-based blended learning and design thinking to enhance creativity and openness to experience. *Cogent Education, 12*(1), 2500760. https://doi.org/10.1080/2331186X.2025.2500760

Yustiqvar, M., et al. (2024). The impact of biopreneurship project-based science learning on students' entrepreneurial creativity. *JPII (Jurnal Pendidikan IPA Indonesia), 13*(3), 436–446.

© 2026 Author. Published by CV. Bimbingan Belajar Assyfa, Indonesia.