Education and Human Development Journal Vol. **10** No.**2**, 173–185 (2025)
doi: 10.33086/ehdj.v10i2.7958

EHDJ | Education and Human Development Journal

ARTICLE

Enhancing student independence and creativity: Experimental research using PBL with flipped classroom

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(Received: 22 July 2025; Accepted: 22 September 2025; Published: 30 September 2025)

Abstract

Conventional learning still struggles to foster student independence and creativity, especially in the era of the Merdeka Curriculum, which emphasizes a flexible approach. The purpose of this study is to investigate how the flipped classroom-based project-based learning (PBL) model affects the independence and creativity of fifth-grade students at Pejagan 1 Elemntary School. Thru the use of a true experimental research design with a non-probability sampling method and IBM SPSS v.21 for data analysis, this approach was proven to significantly improve students' creativity (sig. 0.000 < 0.05) and students' independence (sig. 0.000 < 0.05). The results of this research are relevant to 21st-century learning and support the use of the Merdeka Curriculum. Teachers are advised to use this learning model to help students reach their full potential in a more autonomous and innovative way.

Keywords: Learning Model, Project Based Learning, Flipped Classroom, Learning Independence, Student Creativity

1. Introduction

Modern education requires a more student-centered, contextual, and flexible approach. Academic knowledge alone is no longer sufficient; education must also cultivate critical thinking, creativity, communication, teamwork, and a resilient and adaptable character ([1]). Students today must be prepared to face increasingly complex learning challenges, both inside the classroom and in real-life situations. To address these challenges, the quality of learning must be improved through engaging and relevant tactics ([2]; [3]). One effective strategy is adjusting the learning model to suit the subject matter and student characteristics. Well-designed learning models can enhance conceptual understanding, boost student enthusiasm, and encourage active participation in the educational process ([4]; [5]).

However, not every teaching model is effective in every classroom. Several aspects must be considered when choosing a learning model, including students' learning styles, the complexity of the

 ISSN 2541-0156 (print), 2599-0292 (online).

subject, the availability of facilities and media, and the teacher's ability to manage the process effectively ([6]). Teachers play a key role in identifying the most suitable tactics because they understand classroom dynamics and the unique needs of their students. Flexible and varied learning approaches are also necessary to accommodate students' diverse interests and talents. Some learners thrive in project-based environments, while others may prefer discussion-based or self-exploration methods. Therefore, teachers must be fully aware of their students' learning preferences to design the most effective classroom experiences ([7]).

A wide range of learning models has been developed and tested in educational contexts, such as inquiry-based learning, project-based learning, cooperative learning, and technology-integrated methods. Each of these models comes with distinct advantages and challenges, and their implementation must be adapted to real classroom conditions ([8];[9]). Ultimately, teaching models are essential for raising educational standards and ensuring meaningful learning outcomes. The right model serves as a bridge between theory and practice, between teachers and students, and between learning objectives and results. For this reason, teachers must continuously assess, adapt, and create strategies that remain student-centered, contextual, and relevant.

A student-centered, contextual, and adaptive approach is needed in modern education because academic knowledge alone is no longer sufficient. Critical thinking, creativity, communication, teamwork, and a resilient and flexible character are all 21st-century skills that the educational process must be able to promote. Learning problems for students are becoming increasingly complex, making it necessary to use engaging and relevant methods to improve the quality of learning.

Adapting the learning model to the subject matter and student characteristics is an important tactic for increasing active engagement, learning enthusiasm, and conceptual understanding. The success of a learning model is greatly influenced by students' learning styles, the complexity of the subject matter, available facilities, and the teacher's ability to manage the class. Therefore, teachers must choose teaching strategies that match classroom demands and dynamics, while also considering students' diverse interests and abilities.

Students may respond more positively to project-based learning, feel more comfortable with discussions, or prefer independent inquiry; thus, flexible approaches are needed to accommodate these preferences. Although various learning models—such as inquiry-based learning, project-based learning, cooperative learning, and technology-based learning—have been widely studied, their implementation must always be adjusted to actual classroom conditions. Selecting the right model helps strengthen teacher-student relationships, bridge theory and practice, and direct learning toward optimal results.

A learning model itself is a predetermined design or pattern that serves as a guide for lesson planning in the classroom ([10]). It provides a conceptual framework explaining a structured and systematic approach to teaching and learning in order to achieve objectives effectively and efficiently. The model encompasses strategies, methods, and techniques used by educators to organize interactions among students, teachers, resources, and the learning environment. When applied appropriately, it guides structured, goal-oriented, and learner-centered educational experiences.

In practice, various models are applied, such as project-based learning, problem-based learning, cooperative learning, discovery learning, and flipped classrooms. Each model has its strengths and weaknesses, and the choice depends on learning objectives, resources, student characteristics, and the surrounding social and technological context. In the digital era and within the Merdeka Curriculum, active, collaborative, and experiential learning approaches are increasingly vital to foster independent, creative, and adaptable learners. Among these approaches, the project-based learning (PBL) model has gained significant attention ([11]). PBL presents students with complex, real-world problems that encourage observation, investigation, and group analysis ([12]). Through this

approach, students actively conduct research, ask questions, explain findings, and engage in collaborative problem-solving ([13]). The products they create and present stem directly from their investigative results ([14]; [15]).

Project-Based Learning is a student-centered model in which learners take responsibility for completing meaningful real-world projects that reinforce their academic understanding. Rather than passively receiving knowledge, students investigate real-life issues, design solutions, and produce outputs that can be publicly displayed. From preparation through implementation and reflection, PBL develops critical thinking, teamwork, communication, and creativity through a systematic process. Typically, contextual and interdisciplinary, PBL connects academic content with real-world applications. This makes it especially relevant in Indonesia, where it supports the Pancasila Student Profile and aligns with the Merdeka Curriculum's emphasis on experiential learning. With PBL, students become active participants responsible for their own progress, while teachers act as facilitators who guide their discovery and exploration process.

The application of the project-based learning model can also be supported by a flipped classroom approach. The PBL model based on a flipped classroom allows for transforming individual learning tasks into tasks that students can complete at their own pace, thereby freeing up classroom time by engaging students in a more in-depth and comprehensive learning experience through the use of creative, practical, cooperative, and active subject matter applications that typically require high-level learning abilities ([16]; [17]; [18]).

The flipped classroom is a cutting-edge educational approach that reverses the conventional classroom method. In this model, discussions, exercises, and problem-solving are conducted in person, while the material is delivered outside of class, typically thru videos, digital modules, or self-study materials. This method makes learning more dynamic, collaborative, and student-centred by asking students to prepare before class. This model allows teachers to focus more on guiding and directing students rather than simply imparting knowledge. In the context of technology-based learning and a curriculum that demands the development of 21st-century skills such as communication, critical thinking, and self-directed learning, this method is ideal for use. The flipped classroom is becoming increasingly popular in Indonesia as more people gain access to digital devices and there is a growing demand for personalized and flexible learning. This method not only helps students understand the subject matter more deeply, but also teaches them how to manage their time, obligations, and independent learning techniques.

The use of the project-based learning model based on a flipped classroom also helps students improve their independence ([19]). Independence in learning refers to a student's capacity to motivate themselves, make responsible decisions, and manage resources efficiently ([20]; [21]). It emphasizes how students take control of their education, preparing them for success both in the classroom and in the workplace ([22]). Learning independence demonstrates a readiness and willingness to take responsibility for one's own learning journey.

Students with high learning independence are more likely to actively explore content, show strong intrinsic motivation, and apply effective strategies to overcome learning challenges. In the context of 21st-century education, developing independence is an essential skill because students must continuously learn in a dynamic and technologically advanced world. Once independence is achieved, students often demonstrate creativity in solving problems related to the material being taught ([23]).

Creativity, in this sense, is the ability to generate new and practical ideas or behaviors, especially when faced with complex problems or situations that demand unique solutions ([24]; [25]). In the classroom, student creativity is reflected in cognitive processes such as idea generation and flexible thinking ([26]). Techniques such as "creative learning" allow students to use their imagination to expand knowledge and understanding based on their own discoveries ([27]; [28]).

Moreover, student creativity extends beyond artistic expression to encompass adaptive, elaborative, and innovative thinking across academic domains. It involves problem sensitivity, theory development, solution testing, and effective communication. Creativity is demonstrated when students generate concepts, design action plans, and produce original outputs or solutions. In the global era, creativity is also tied to freedom of thought and the courage to take intellectual risks, both of which are vital for fostering innovation and competitiveness. Finally, independence and creativity are two interconnected elements that reinforce each other in project-based learning and flipped classroom strategies. Students who are encouraged to learn autonomously and engage in real-world, problem-based tasks not only enhance their academic performance but also grow into flexible, creative, and responsible individuals.

The flipped classroom model integrated with project-based learning (PBL) has been proven effective in fostering student independence. Independent learners are characterized by their ability to self-motivate, make sound decisions, and manage time and resources efficiently. Such students also take initiative in acquiring knowledge, demonstrate resilience in overcoming obstacles, and apply appropriate strategies to succeed in learning. Since lifelong learning has become essential in a rapidly changing, technology-driven world, independence is a critical competency for 21st-century education.

In addition to independence, active learning also nurtures creativity, which is central to problem-solving in complex situations. Creativity involves producing original, practical, and relevant solutions. Within the classroom, creative students employ imagination to interpret material, generate innovative ideas, and engage flexibly in intellectual risk-taking. This capacity is not restricted to artistic expression; it extends to flexible thinking and the courage to propose new approaches. When applied in flipped classrooms and PBL, creativity and independence reinforce one another, enabling students to take ownership of real-world projects and enhance their overall learning outcomes.

Several studies provide empirical support for the benefits of PBL and flipped classrooms. [29] found that PBL enhances student creativity, particularly in fluency, flexibility, originality, elaboration, and evaluation, while also improving overall learning outcomes. Similarly, [30] demonstrated that PBL significantly improves student independence and learning discipline in elementary schools, with independent samples t-tests revealing notable differences between experimental and control groups. Research by [31] further confirmed that PBL in IPAS lessons helped fifth-grade students at SDN 3 Baledono become more active, disciplined in time management, and responsible for their tasks. However, while these studies highlight the separate impacts of PBL and flipped classrooms, few explore the combined effects of these two approaches on fostering both independence and creativity.

Despite the positive outcomes of prior investigations, existing studies often treat PBL and flipped classrooms as distinct models rather than examining their integrated application. In particular, there is limited empirical evidence regarding how the flipped classroom-based PBL approach influences the independence and creativity of elementary school students in Indonesia. This research gap underscores the need for studies that explore the synergy between the two methods to determine their combined effectiveness in supporting 21st-century competencies.

Observations at Pejagan 1 Elementary School reveal that fifth-grade students exhibit low levels of independence and creativity. Many students still rely heavily on teachers as the sole source of information, show limited proactivity in learning, and demonstrate weak creative thinking skills ([32]). Similarly, [33] observed that students often wait for teacher guidance before completing tasks, even when resources are available, which limits self-directed learning and encourages peer answer-sharing. These challenges highlight the need for innovative instructional strategies that integrate flipped classrooms with PBL to address both independence and creativity simultaneously.

Given these considerations, the current study investigates the effectiveness of implementing a flipped

classroom-based PBL model to enhance the independence and creativity of fifth-grade students at Pejagan 1 Elementary School. This research aims to contribute to the development of more active, contextual, and student-centered learning models that align with the demands of 21st-century education.

2. Methods

This study uses a pretest-posttest control group design and takes a quantitative approach with a true experimental design. This design was chosen because it allows for strict control over unrelated factors and enables researchers to assess the impact of the treatment on the dependent variable impartially. The application of the project-based learning (PBL) model based on the flipped classroom to improve student independence and creativity is the treatment that will be tested in this study. Researchers can directly compare the results of two groups using this design: the experimental group, which receives the treatment, and the control group, which does not. Pretest and posttest participation allows for a quantitative analysis of changes in each group, enabling precise and controlled measurement of intervention effectiveness ([34]).

There are 65 fifth-grade students at SDN Pejagan 1 Bangkalan who are the subjects of this research. Researchers used a purposive sampling approach, considering similarities in characteristics between classes, such as the number of students, academic background, and gender distribution, to create a representative sample and prevent bias. The two classes selected were V-A and V-B, each with 30 students as the research sample. Student preferences or their initial conditions did not affect the distribution of treatments because the experimental and control groups were randomly selected (random assignment). This method is crucial for maintaining the internal validity of the research and ensuring that variations in results are truly caused by the treatment and not by other uncontrolled variables ([35]).

The closed-ended questionnaire is the primary tool used in this study to measure two key factors: student creativity and learning independence. Valid elements from both concepts are reflected in the questionnaire designed using indicators relevant to educational theory and previous research findings ([36]). Before being used for data collection, the questionnaire, which uses a 5-point Likert scale, was tested for reliability using Cronbach's Alpha coefficient and for content validity by education specialists. The validity and reliability of an instrument are important prerequisites for the collected data to accurately reflect the monitored conditions and be suitable for further analysis ([37]).

Using IBM SPSS Statistics Version 21 software for Windows, data analysis was performed concurrently with many stages of statistical testing. Before using parametric testing, the first step involves a normality test to ensure the data distribution shows a normal pattern. To evaluate the similarity of variances between groups, a homogeneity test was then performed. Researchers also tested the validity and reliability of the instrument to ensure it was of high quality. After the data met the criteria, an independent samples t-test was used to assess the hypothesis and see if the experimental and control groups differed significantly from each other after the treatment was administered. Referring to the significance threshold set at = 0.05, a t-test was performed on the interval scale data obtained from the post-test results. The conclusion about how well the PBL learning paradigm based on Flipped Classroom promotes student independence and creativity is based on test findings ([38]; [39]).

3. Results And Discussion

3.1 Results

The findings of evaluating the effect of the project-based learning model based on the flipped classroom on student independence through an independent sample t-test are as follows:

Table 1. Statistical Description of the Average Scores Obtained by Students on Learning Creativity.

	Class	N	Mean	Std. Deviation	Std. Error Mean
Learning Creativity	Experiment's class	30	52.60	7.582	1.384
	Control's class	30	42.33	11.926	2.177

According to the information presented in Table 1, the average learning creativity variable for the experimental class is 52.60, while the average for the control class is 42.33. The graph of the difference in average scores obtained by students for learning independence is as follows:

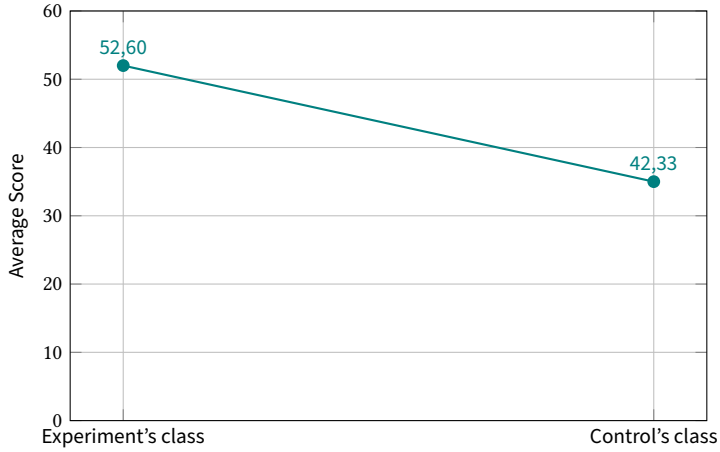

Figure 1. Graph of Average Scores Obtained by Students in Relation to Learning Independence

The graph shown in Figure 1, there is a 10.27-point difference between the average scores of the two groups. This difference indicates the impact of the intervention, namely the application of flipped classroom-based project-based learning on student independence. The independent samples T-test was used as the final hypothesis test based on these findings to determine whether the learning independence of 5th-grade students at Pejagan 1 Elementary School was significantly affected by the implementation of the flipped classroom-based project-based learning model. Independent sample t-tests are used to statistically assess the hypothesis, with the following scores obtained:

There is a significant difference or impact from the application of audio-visual-based learning media on learning creativity in the IPAS subject in the 5th grade at SDN Mlajah 2 Bangkalan, as indicated by the t-test findings with a value of 0.000 < 0.05 for independent samples on learning creativity, presented in Table 2. This is because H0 is accepted, and Ha is rejected.

Table 3 shows that students in the experimental class scored an average of 58.57 on the creativity scale, compared to 48.43 in the control group. The graph of the difference in average scores obtained by students for creativity is as follows:

The graph shown in Figure 2, the experimental and control groups have a score difference of 10.14

Table 2. Findings of The Independent Sample T-Test on Learning Independence

Levene's Criteria for Equality of Variances				T-test for Equality of avarage						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error	Difference 95% Confidence Interval of the Difference	
									Lower	Upper
Learni Creativity	Equal variances assumed Equal	Learni Independence	variances assumed	2.868	.096	3.979	58	.000	10.267	2.580
5.102	15.431									
	Equal variances not assumed			3.979	49.151	.000	10.267	2.580	5.082	15.451

Sources: IBM SPSS v 2.0.1

Table 3. Statistical Description of the Average Scores Obtained by Students on Understanding Learning

	Class	N	Mean	Std. Deviation	Std. Error Mean
Stundent's Creativity	Experimen class	30	58.57	5.587	1.020
	Control's class	30	48.43	7.219	1.318

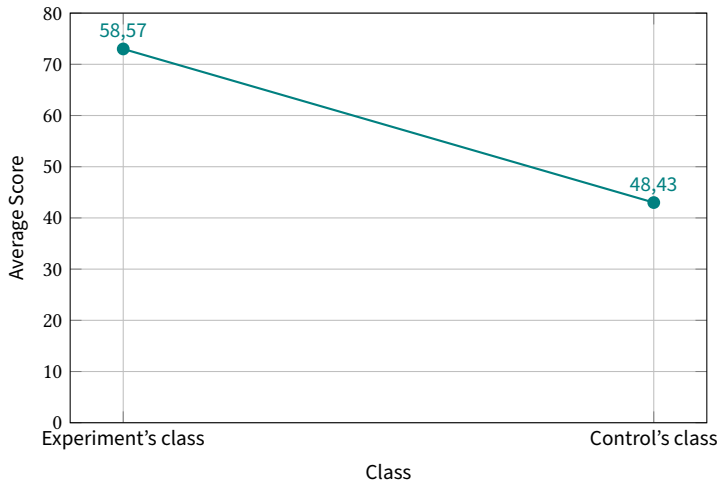

Figure 2. Graph of Average Scores Obtained by Students Against Student Creativity

points. This difference indicates the impact of the intervention, which is the application of flipped classroom-based project-based learning on student creativity. The final hypothesis test, the independent t-test, was used to determine if this difference was significant, with the following results:

Table 4. Findings of The Independent Sample T-Test on Student's Creativity

Levene's Criteria for Equality of Variances				T-test for Equality of avarage						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error	Difference 95% Confidence Interval of the Difference	
									Lower	Upper
Under Learning	Equal variances assumed	7.333	.009	5.907	58	.000	29.800	5.044	19.702	39.898
	Equal variances not assumed			5.907	49.583	.000	29.800	5.044	19.666	39.934

Sources: IBM SPSS v 2.0.1

The analysis results show a significant value of 0.000 < 0.05. As a result, H was rejected and H was accepted, indicating that the creativity of fifth-grade students at Pejagan 1 Elemetary School is significantly influenced using the flipped classroom-based project-based learning model.

3.2 Discussion

According to the findings of the descriptive statistical data analysis, the experimental group and the control group differed significantly in terms of students' learning independence and creativity. The average score for the control group was 94.3, with an average of 42.33 for the creativity variable and 52.60 for learning independence. Comparatively, the experimental group showed a greater improvement, with an average of 48.43 for learning independence and 58.57 for creativity, resulting in a total average of 107. With the scores of the two groups differing by 10.27 points for independence and 10.14 points for creativity, the Flipped Classroom-based Project-Based Learning (PBL) model is beneficial for both.

The research findings also indicate that the creativity and independence of fifth-grade students significantly increased when the Flipped Classroom-based project-based learning model was used. In the context of thematic learning in elementary school, this method has demonstrated its ability to stimulate students to become active and reflective learners, and to enliven the classroom atmosphere thru engaging learning models. The findings of this study are consistent with previous research by [**Syam & Damayanti (2024)**], who investigated the impact of PBL on the creativity of 11th-grade students in the subjects of momentum and impulse at SMAN 3 Samarinda. Syam and Damayanti concluded that the use of PBL significantly improved students' flexible, creative, and elaborative thinking abilities. Another study by Nurhamidah Nurachadijat (2023) also supports this finding, showing that students who learn thru a project-based approach have a higher level of learning independence compared to students taught using conventional methods. Additionally, students responded positively to this learning model because they felt more engaged and responsible for the learning process.

The project-based learning (PBL) model based on the flipped classroom is designed before face-to-face activities begin; students must independently prepare a basic understanding of the subject matter. To ensure students have a basic understanding and are ready to participate in the project activities that will be conducted in class, the teacher provides them with access to learning resources and instructional materials beforehand. Students are encouraged to learn actively, be curious, and gain understanding from direct experience thru this learning model. Fifth-grade students collaborate to complete projects that include creating small items, group presentations, or finding answers to real-world issues related to the lesson theme ([40]). Thru this exercise, students must collaborate with peers, think creatively, and express their thoughts freely. According to observational findings, students increased their expressiveness, developed original ideas, and demonstrated courage in making choices throughout the project ([41]).

From the perspective of independent learning, this method allows students to choose appropriate working methods, determine their own learning pace, and complete tasks without being entirely dependent on the teacher. Teachers observe that students are more proactive in creating work schedules, managing time, and completing tasks responsibly ([42]). This demonstrates how the Flipped Classroom-based Project Based Learning (PBL) model can develop autonomous learners ready to face increasingly challenging learning tasks. The Flipped Classroom-based Project Based Learning (PBL) model also significantly increases student independence because students will begin to get used to learning at their own pace and style by accessing learning materials individually thru digital modules, videos, or other learning resources before class sessions. This encourages the growth of proactive and reflective learning habits ([43]).

Conceptually, Flipped Classroom-based Project Based Learning (PBL) can work well to meet the learning needs of the 21st century, which strongly emphasizes the growth of critical thinking skills, creativity, teamwork, and communication ([44]). The Flipped Classroom-based Project Based Learning (PBL) model is considered a tactical, flexible, and revolutionary alternative. Meanwhile, the flipped classroom approach reverses the traditional flow by providing students with access to learning materials before face-to-face sessions ([45]; [46]). Instead of passively absorbing knowledge, students can actively develop understanding thru inquiry, debate, and reflection when these two methods are combined ([47]). Beside providing knowledge, this learning model shapes students' attitudes toward learning and thinking so they can adapt to changing circumstances. This method proved to be a fun, meaningful learning option for the fifth-grade classroom. Additionally, by encouraging students to work together on projects, this model enhances learning thru the sharing of diverse perspectives and ideas. Thru this model, students have more influence over their own learning process because instructors act as mentors and facilitators, not as information centers ([48]). Therefore, in addition to successfully improving learning outcomes, the Flipped Classroom-based PBL model is also relevant as a learning strategy that comprehensively supports the development of 21st-century skills.

4. Conclusions

Based on the findings of the Independent Samples T-test, which had a significance value of 0.000 (< 0.05), it was proven that fifth-grade students at Pejagan 1 Elemetary School were significantly more independent and creative after implementing the flipped classroom-based project-based learning (PBL) model. This research reaffirms that a relevant and successful strategy for addressing educational difficulties in the 21st century is the integration of project-based learning with self-directed learning using digital media. This methodology not only promotes academic success but also develops students' independence, creativity, and ability to adapt to changing circumstances. These findings have clear practical implications for educators, including the importance of creating lessons that encourage autonomous inquiry, practical problem-solving, and the active use of technology.

Teachers should be facilitators who lead project-based learning and self-reflection processes, not just deliver knowledge. Teachers can increase student participation, develop higher-order thinking skills, and create a more dynamic learning environment by implementing these strategies. The findings of this research provide a strong foundation for creating learning strategies at the higher education level, although it is still limited to elementary school students and has technological limitations such as study time allocation. To provide teachers with a broader reference for implementing this strategy contextually and sustainably, it is recommended to conduct further studies to assess the model's effectiveness in other courses and to research other areas including teamwork, digital literacy, and critical thinking skills.

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