



RESEARCH ARTICLE

Enhancing Motivation and Independence in College Students: A Study on the Problem-Based Learning Model

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ARTICLE INFO	ABSTRACT
Received: Oct 28, 2024 Accepted: Dec 17, 2024	The Problem-Based Learning (PBL) model has become a powerful educational approach aimed at cultivating critical thinking, problem-solving abilities, and self-directed learning in students. This method not only strengthens cognitive skills but also plays a vital role in boosting students' motivation and independence. This research explores the effectiveness of the Problem-Based Learning (PBL) model in boosting students' independence and motivation. A quasi-experimental design with a pretest-posttest control group was employed, involving 64 students enrolled in the Elementary School Teacher Education Program at STKIP PGRI Bangkalan during the 2022–2023 academic year. The students were divided into two groups: Class A, which acted as the experimental group, and Class B, which served as the control group, each consisting of 32 students. Data on students' motivation and independence were gathered using a questionnaire-based non-test instrument. The results indicated a statistically significant increase in both motivation and independence among students who experienced the PBL model, with p-values of less than 0.05 for both variables. These outcomes highlight the PBL model's strong positive influence on student motivation and independence, affirming its effectiveness as a pedagogical strategy in educational environments. This study recommends the implementation of the Problem-Based Learning (PBL) model in other courses. It is important to assess whether these courses would benefit from the same model or if different instructional approaches should be applied.
<p>Keywords</p> Motivation Independence College Students Problem-Based Learning Model	
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INTRODUCTION

Even in the twenty-first century, learning has become increasingly complex, requiring specific skills and abilities to address multifaceted problems. Learning is deeply interconnected with the ever-evolving contexts of daily life. This rapid evolution presents a challenge for educators, who must adapt to these changes. To equip students for the diverse challenges of the modern world, education must provide multiple opportunities for them to adjust to new and shifting contexts (Internasional et al., 2023). An essential skill that must be taught to the next generation is problem-solving. The Indonesian Ministry of Education and Culture continues to prioritize the enhancement of problem-solving skills, as they are crucial for addressing issues, making decisions, and evaluating actions (Daryanes et al., 2023). There is a need to place greater emphasis on professional practice in higher education, moving beyond traditional teaching methods to foster deeper learning, critical thinking, and creativity (Louw & Deacon, 2020). The problem-based learning approach is particularly effective in developing students' self-regulation skills (Hidajat, 2023). By promoting active and independent

learning, this innovative teaching method is likely to improve students' understanding of the material (Li et al., 2020). Ideally, students will enhance their abilities in statistical concepts, including data analysis and both descriptive and inferential statistics, through such learning. To foster greater engagement and creativity in their research and future endeavors, it is necessary to employ creative and inventive teaching strategies (Susbiyanto et al., 2019). However, the application of problem-based learning models in statistics courses is still limited.

Problem-Based Learning (PBL) is often referred to as Inquiry-Based Learning due to its student-centered approach and effectiveness (Liu & Pásztor, 2022). PBL is grounded in cognitive constructivist theory, following Piaget's view that students of all ages actively engage in gathering information and constructing their own knowledge. In contrast, Vygotsky's theory posits that intelligence develops as individuals work to resolve the challenges presented by new, complex experiences. This approach, facilitated by an instructor, is known for its student-centered and autonomous learning style. It has been widely applied across various levels of education (Alaloul & Qureshi, 2022). PBL helps higher education students develop problem-solving, critical thinking, clinical reasoning, independence, teamwork, flexibility, and motivation (Joshi et al., 2020). By integrating knowledge across different scientific fields and fostering a lifelong passion for learning, PBL aims to enhance students' skills through teamwork and clinical problem-solving (Bai et al., 2017). In this method, students typically work in small groups to explore and address uncertainties related to course topics, addressing their own learning needs and investigating potential issues in detail (Kang & Lee, 2023; Ariani et al., 2024). Unlike traditional methods that focus on rote memorization of facts, PBL emphasizes tackling real-world problems to enhance student learning (Joshi et al., 2020). Various materials can be used to stimulate student learning within the PBL framework (Servant-Miklos, 2019b; Jam et al., 2011).

Problem-based learning (PBL) emphasizes student activity and involves presenting problems that students frequently encounter in their daily lives. It requires students to apply concepts and knowledge they have acquired to address these real-life challenges, which enhances their perspective on learning compared to simple factual presentations. Implementing PBL can improve critical thinking, problem-solving abilities, cognitive skills, and overall performance when contrasted with predominantly lecture-based instruction (Joshi et al., 2020). The goal of PBL is to guide students toward mastering lessons through independent learning and newly acquired knowledge (Boye & Agyei, 2023). The primary focus is on problem formulation and problem-solving, using these skills as a central learning tool (Andersen & Rösiö, 2021).

Interactive PBL typically involves three key phases: the initial problem presentation and analysis, orientation, and synthesis, which together enhance engagement and learning effectiveness (Chao et al., 2022). In PBL, students define their learning objectives through specific challenges or scenarios, aiming to build new understanding and insights. They may create models to visualize how issues emerge and develop solutions (Ee et al., 2023). The Problem-Based Learning (PBL) process involves placing students in small groups to collaborate and learn independently (Servant-Miklos, 2019a). This approach differs from other learning models in several ways: 1) students are at the center of the learning process; 2) they work in small groups where roles frequently change; 3) the teacher acts as a facilitator; 4) students encounter real problems from the start; 5) problems guide the learning objectives and mastery of the subject matter; and 6) new knowledge is acquired through independent learning (Boye & Agyei, 2023).

PBL is particularly effective for fostering critical thinking among Gen-Z students. The method aligns with the principles of critical thinking, requiring students to analyze, inquire, synthesize, and apply their knowledge creatively. It encourages students to prioritize issues, assess what is known versus unknown, and evaluate different viewpoints (Seibert, 2021). Integrating PBL into regular learning enhances student engagement and motivation (Dring, 2019).

Motivation can be categorized into intrinsic and extrinsic types. Intrinsic motivation is the innate drive to seek challenges and opportunities related to cognitive and social development, while extrinsic motivation comes from external rewards and incentives (M. Nur Hakim et al., 2022;

Nurnindyah et al., 2023). Students' motivation can lead to more active learning behaviors. Independence in learning, defined as the ability to engage in educational activities autonomously, is crucial (Sundari et al., 2022). Students should be encouraged to develop learning independence, which involves pursuing interests and activities without external assistance, relying on their motivation, will, and responsibility. High-quality teaching motivation is essential, as teachers are expected to deliver exceptional education. Motivated, qualified, and dedicated teachers are crucial for preparing future generations.

The Problem-Based Learning (PBL) model has gained substantial attention for its potential to enhance student motivation and learning independence, particularly in challenging subjects like statistics. This instructional strategy, which centers around presenting students with real-world problems, engages learners in an active and self-directed learning process (Barrows, 2023). The PBL model is grounded in constructivist theories, which emphasize learning through problem-solving and collaboration, allowing students to explore and apply statistical concepts in meaningful contexts (Hmelo-Silver & Barrows, 2024). In statistics courses, where students often struggle with abstract concepts and complex data analysis, PBL offers a framework that can make learning more relevant and engaging. By tackling authentic problems, students can better understand the applicability of statistical methods and see their relevance in real-world scenarios (Yew, E. H. J. & Goh, K., 2024). This relevance not only fosters deeper learning but also significantly boosts motivation by connecting classroom learning to practical applications (O'Neill & McMahon, 2023).

Research supports the effectiveness of PBL in increasing student motivation and learning independence. For instance, studies have shown that PBL can enhance intrinsic motivation by creating a more interactive and engaging learning environment (Gijbels, Dochy, Van den Bossche, & Segers, 2023). The problem-solving nature of PBL helps students see the value of statistical techniques beyond theoretical knowledge, promoting a greater sense of ownership and investment in their learning process (Chen et al., 2024). Additionally, PBL encourages students to develop self-directed learning skills, such as critical thinking and self-regulation, which are essential for success in statistics and other analytical fields (Jonassen, 2023). Problem-Based Learning (PBL) emerges as a powerful pedagogical strategy that aligns with this need. Rooted in cognitive constructivist theory, PBL positions students as active participants in their learning journey, fostering self-regulation, critical thinking, and a deeper understanding of the material. This student-centered approach not only enhances engagement but also cultivates the problem-solving skills necessary for success in today's complex world (Schön, 2023).

In the context of statistics education a field often perceived as abstract and challenging PBL offers a framework that makes learning more relevant and engaging. By confronting students with real-world problems, PBL helps bridge the gap between theoretical knowledge and practical application, thereby increasing both motivation and learning independence. Research has consistently shown that PBL can transform the educational experience (Kolb, 2024), making it more interactive, collaborative, and aligned with students' future career goals (Boud & Feletti, 2024).

Given the critical importance of these skills in the modern world, this study seeks to explore the impact of the Problem-Based Learning Model on college students' motivation and learning independence, particularly within the challenging domain of statistics education. By investigating how PBL can enhance student engagement and autonomy, this research aims to contribute valuable insights to the ongoing discourse on educational innovation.

MATERIALS AND METHODS

This study utilized a quasi-experimental research methodology, employing an experimental sample class as the experimental group and a control sample class as the control group, with the independent variable being the instructional model (Septianto et al., 2024). The dependent variables were student motivation and independence. The research followed a pretest-posttest control group design to compare the results of pretests and posttests on motivation and independence. Two sample classes were involved: one experimental and one control. Both groups completed a pretest, after which the

experimental group was taught using the Problem-Based Learning (PBL) model, while the control group received traditional instruction. A posttest was administered to both groups at the conclusion of the study to measure changes in motivation and learning independence.

The study was conducted at STKIP PGRI Bangkalan from April to May 2023, involving 64 students of elementary school education study program, divided into two classes. A saturated sampling technique, or census, was used, with 32 students in Class A serving as the experimental group and 32 students in Class B as the control group.

Data were collected using a questionnaire consisting of 15 items related to student motivation and independence. The questionnaire utilized a Likert scale, where responses ranged from Strongly Agree (5) to Strongly Disagree (1). The validity and reliability of the questionnaire are presented in Tables 1 and 2, respectively. The validity tests confirmed that all questionnaire items were valid, while the reliability tests demonstrated that each item was consistent and dependable. Data analysis was conducted using SPSS 25, and the interpretation of the SPSS output indicated a significant difference in the data between study subjects when the significance value was 0.05.

Table 1 Validity of the Motivation and Independence Questionnaire

Variable	Items	r-xy	r-table	Description
Motivation (X1)	X1-1	0.696	0.3494	Valid
	X1-2	0.596	0.3494	Valid
	X1-3	0.626	0.3494	Valid
	X1-4	0.596	0.3494	Valid
	X1-5	0.596	0.3494	Valid
	X1-6	0.626	0.3494	Valid
	X1-7	0.696	0.3494	Valid
	X1-8	0.696	0.3494	Valid
	X1-9	0.492	0.3494	Valid
	X1-10	0.544	0.3494	Valid
	X1-11	0.626	0.3494	Valid
	X1-12	0.626	0.3494	Valid
	X1-13	0.389	0.3494	Valid
	X1-14	0.626	0.3494	Valid
	X1-15	0.696	0.3494	Valid
Independence (X2)	X2-1	0.428	0.3494	Valid
	X2-2	0.376	0.3494	Valid
	X2-3	0.376	0.3494	Valid
	X2-4	0.784	0.3494	Valid
	X2-5	0.428	0.3494	Valid
	X2-6	0.396	0.3494	Valid
	X2-7	0.920	0.3494	Valid
	X2-8	0.784	0.3494	Valid
	X2-9	0.920	0.3494	Valid
	X2-10	0.784	0.3494	Valid
	X2-11	0.784	0.3494	Valid
	X2-12	0.920	0.3494	Valid
	X2-13	0.376	0.3494	Valid
	X2-14	0.920	0.3494	Valid
	X2-15	0.784	0.3494	Valid

Table 2 Reliability of the Motivation and Independence Questionnaire

Variable	Lecene Statistic	Df1	Df2	Sig.	Description
Pretest Motivation	0.011	1	62	0.918	Reliable
Posttest Motivation	0.216	1	62	0.644	Reliable
Pretest Independence	0.712	1	62	0.402	Reliable
Posttest Independence	2.504	1	62	0.116	Reliable

RESULTS

The Influence of PBL on Motivation

Table 3 Descriptive Statistics of Motivation

Statistics	Control Group		PBL	
	Pretest	Posttest	Pretest	Posttest
N	32	32	32	32
Mean	45.63	61.16	49.09	65.28
Standard Deviation	5.791	4.009	5.408	3.494
Min	34	51	40	58
Max	55	70	58	72

Based on the table above, it shows descriptive statistics on motivation variables for the control and PBL groups, including N, mean, standard deviation, Min, and Max.

Table 4 Normality of Test Motivation

Group	p	Sig
Pretest PBL	0.028	Abnormal
Posttest PBL	0.872	Normal
Pretest Control Group	0.333	Normal
Posttest Control Group	0.965	Normal

The table above shows that the PBL pretest was abnormal and for the PBL posttest, Pretest Control Group, and Posttest Control Group the data distribution was normal.

Table 5 Homogeneity Test

Group	p	Sig
Pretest	0.918	Homogene
Posttest	0.644	Homogene

Based on the results above, all data is homogeneous. The data distribution is homogeneous but some are not normal so it is continued with Mann-Whitney U Test.

Table 6 Mann-Whitney U Test of Motivation

Variable	Sig
Motivation	.000

The results of the study showed that the p value < 0.05 so that there is a significant influence of PBL on motivation. Below is a graph of the motivation variable.

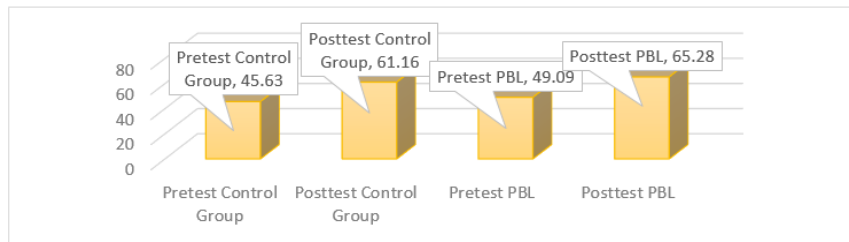


Figure 1 Pretest and Posttest Motivation Improvement

The bar chart above shows that the increase in the PBL group is greater than the control group. Although the control group also increased, the PBL group's increase was more significant.

The Influence of PBL on Independence

Table 7 Descriptive Statistics of The Independence

Statistics	Control Group		PBL	
	Pretest	Posttest	Pretest	Posttest
N	32	32	32	32
Mean	51.56	62.81	52.56	66.06
Standard Deviation	2.299	5.343	3.015	4.457
Min	45	52	43	61
Max	56	70	61	74

Based on the table above, it shows descriptive statistics on independence variables for the control and PBL groups, including N, mean, standard deviation, Min, and Max.

Table 8 Normality of Test

Group	p	Sig
Pretest PBL	0.19	Normal
Posttest PBL	0.003	Abnormal
Pretest Control Group	0.263	Normal
Posttest Control Group	0.25	Normal

The table above shows that the PBL posttest was abnormal and for the PBL pretest, Pretest Control Group, and Posttest Control Group the data distribution was normal.

Table 9 Homogeneity Test

Group	p	Sig
Pretest Independence	0.402	Homogene
Posttest Independence	0.116	Homogene

Based on the results above Table 9, all data is homogeneous. The data distribution is homogeneous but some are not normal so it is continued with the Mann-Whitney U Test.

Table 10 Mann-Whitney U Test of Independence

Variable	Sig
Independence	.000

The results of the study showed that the p value < 0.05 so that there is a significant influence of PBL on independence. Below is a graph of the independence variable.

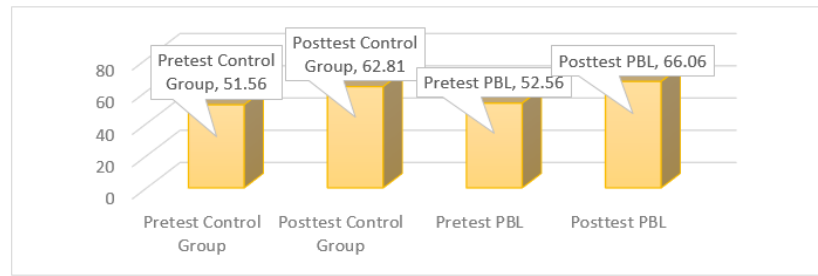


Figure 2 Pretest and Posttest Independence Improvement

The bar chart Figure 2 above shows that the increase in the PBL group is greater than the control group. Although the control group also increased, the PBL group's increase was more significant.

DISCUSSION

Based on the research results, it shows that there is a significant influence of PBL on college student motivation and independence in Statistics lectures. This is likely due to the suitability of using the PBL learning model. The Problem-Based Learning (PBL) Model has emerged as an effective pedagogical approach for enhancing student motivation and learning independence. This student-centered method, which involves engaging learners with real-world problems, has shown significant benefits across various academic fields, including statistics (Barrows, 2023). This discussion explores how the PBL model can be utilized to boost both student motivation and independence in statistics courses, supported by recent research.

Student motivation is essential for effective learning, particularly in challenging subjects like statistics. The PBL model increases motivation by connecting statistical concepts to practical applications, making learning more relevant and engaging. Studies indicate that PBL significantly enhances intrinsic motivation. Students in PBL settings reported higher motivation levels and greater engagement compared to those in traditional lecture-based environments (O'Neill & McMahon, 2023). This heightened motivation is attributed to the problem-solving nature of PBL, which helps students appreciate the practical value of statistical techniques and fosters a deeper connection to the (Hmelo-Silver & Barrows, 2024). Furthermore, PBL promotes active learning, which is associated with increased motivation. The iterative process of tackling complex problems and receiving feedback encourages students to engage more deeply with the content (Boud & Feletti, 2024). The autonomy embedded in PBL enables students to take control of their learning, further enhancing their motivation and commitment to mastering statistical concepts (Savery, 2024).

Learning independence is a crucial educational objective, especially in a field as analytical as statistics. The PBL model supports independence by requiring students to manage their learning and collaborate to solve problems (Chen, Zhang, & Liu, 2024). This approach fosters the development of self-directed learning skills, such as critical thinking, problem-solving, and self-regulation, which are vital for success in statistics (Jonassen, 2023). Research highlights the positive impact of PBL on learning independence. For example, students in PBL-based statistics courses showed greater autonomy compared to those in traditional settings (Miller & McCoy, 2023). This increased independence is supported by the collaborative nature of PBL, which encourages peer learning and helps students take responsibility for their learning outcomes (Williams, Cox, & Reddy, 2024). Additionally, PBL promotes reflective practices, which are crucial for developing learning independence. Regular feedback and reflection enable students to assess their progress and identify areas for improvement, thereby enhancing their ability to manage their learning more effectively (Anderson & Duffy, 2023).

To implement the PBL model effectively in statistics courses, educators should design real-world problems that align with students' interests and career goals, ensuring that these problems meet course objectives (Kolb, 2024). Well-designed problems should challenge students to apply statistical concepts in meaningful ways, thereby enriching their learning experience. Collaboration is a key

component of PBL, and instructors should facilitate group work and discussions to support students in problem-solving. Research suggests that collaborative learning not only improves individual performance but also promotes a deeper understanding of statistical concepts (Gijbels, Dochy, Van den Bossche, & Segers, 2023). Incorporating regular feedback and reflective practices is also essential to help students evaluate their progress and develop greater independence (Schön, 2023).

The Problem-Based Learning Model offers substantial benefits for increasing student motivation and learning independence in statistics courses. By engaging students with real-world problems and fostering active, collaborative learning, PBL makes statistical concepts more accessible and relevant. Recent research supports the effectiveness of PBL in enhancing both motivation and independence, making it a valuable strategy for educators aiming to improve student outcomes in statistics.

CONCLUSION

The conclusion of this research is that the Problem-Based Learning Model was found to have a significant impact on both college students' motivation and their learning independence. A limitation of this study is that it focused exclusively on Statistics courses. Therefore, it is recommended to extend the application of Problem-Based Learning (PBL) to other subjects based on these findings.

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ETHICAL CONSIDERATIONS

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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