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Problem-Based Entrepreneurship Learning: The Role of Self-Efficacy Moderation in Strengthening Students' Creative Thinking

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ABSTRACT

The low level of creative thinking skills among students is one of the main challenges in entrepreneurship education in higher education. The learning pattern, which is still dominated by a one-way approach, means that students have little opportunity to discuss, develop ideas, and express creative ideas. This situation calls for learning strategies that can actively and reflectively stimulate creative thinking skills. This study aims to analyse the effectiveness of the Problem-Based Learning (PBL) model on students' creative thinking skills in entrepreneurship courses, considering the role of self-efficacy as a moderating variable. The research used a quasi-experimental approach with a pretest-posttest factorial design, involving seventh semester A students as the experimental class and seventh semester B students as the control class in the odd semester of the 2024-2025 academic year in the Law Study Programme at Kuningan University. Data were collected through creative thinking tests and self-efficacy questionnaires, then analysed using a two-way ANOVA test to examine the main effects of the interaction between variables. The results showed that: (1) students who learned using the Problem-Based Learning model had higher levels of creative thinking compared to those who learned using the lecture method; (2) self-efficacy had a significant effect on students' abilities; and (3) there was a meaningful interaction between the Problem-Based Learning model and self-efficacy, as indicated by greater increases in creativity through the application of Problem-Based Learning. These findings confirm that the integration of Problem-Based Learning with the strengthening of self-efficacy is an effective strategy in learning. In addition, this study can contribute theoretically to the development of a constructivist-based entrepreneurial learning model in which students successfully solve problems contextually.

Keywords: Problem Based Learning, Self-Efficacy, Creative Thinking, Entrepreneurship Learning.

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INTRODUCTION

In the 21st century, marked by rapid innovation and complex global challenges, creative thinking has become an essential skill that every individual must possess. The balance between technical skills (hard skills) and non-technical skills (soft skills) such as critical thinking, collaboration, communication, and creativity is key to developing human resources that are competitive and adaptable to change (Dilekçi & Karatay, 2023; Redhana, 2019; Mulya et al., 2023; Mardiyantoro et al., 2022). In the context of higher education, entrepreneurship courses play a strategic role in fostering creativity and innovation among students because, normatively, entrepreneurship requires individuals to think originally, take risks, and create new solutions of value.

However, the reality of entrepreneurship learning in various universities still shows weaknesses. The learning process, which tends to be one-way and lecturer-centred, causes students to be passive and lack opportunities to explore creative ideas and concepts. As a result, students' creative thinking skills have not developed optimally. In fact, various studies show that creative thinking skills have a positive relationship with academic achievement and problem-based learning intelligence (Hew & Huang, 2023; Varlık et al., 2024; Zhuang et al., 2021). Students with high levels of creativity are better able to produce innovative ideas and demonstrate better learning performance than those who think convergently (Yacub et al., 2022; Herlina, 2025).

Empirical evidence shows that students' creative thinking abilities are still relatively low. The results of the international surveys Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA) show that Indonesia ranks 64th out of 65 countries in terms of creative thinking (Pambudi, 2022). These findings indicate the need for innovative efforts in designing learning strategies that can stimulate student creativity and innovation. This low achievement is also evident from the results of internal assessments in several study programmes, where the average score for students' creative thinking skills is still below the optimal category (Ruqoyyah et al., 2020; Chen & Yin, 2026).

The low level of students' creative thinking skills can be caused by various factors, both internal and external. External factors include the application of learning models. This means that to overcome this problem, a learning model is needed that can ensure students have learning and innovation skills. As stated by Zamroni & Mahfudz, (2009), there are four ways to improve critical thinking skills, namely '1) Specific learning models 2) Assignments to critique books 3) The use of stories 4) The use of Socratic questioning'. In line with the above explanation, the appropriate model to improve students' critical thinking skills is to apply the Problem-Based Learning (PBL) learning model, because this model makes students more critical as it is based on presenting real problems or case studies where students can discuss with their friends to find and solve a problem together, discuss and exchange opinions to complete the case study, and conclude the case study that has been worked on by the students. This is in line with Amir (2016), who argues that the closer the problem is to authentic life, the better the effect on learning agility. This opinion is also reinforced by research conducted by Sitompul (2021), which states that there is a significant influence of the Problem-Based Learning (PBL) model on the improvement of critical thinking skills. This is because learning activities using the Problem-Based Learning (PBL) model involve students' ability to think creatively to solve real problems (Lee et al., 2026).

Creative thinking skills develop when students are actively involved in contextual and reflective problem-solving processes (Yildiz & Yildiz, 2021). This process encourages students to integrate their experiences, knowledge and intuition to produce innovative new solutions. Therefore, a learning approach oriented towards real problem-solving activities is needed, rather than simply transferring knowledge. One relevant approach is Problem-Based Learning (PBL). The PBL model is in line with the constructivist paradigm, which views students as active subjects in constructing knowledge through the exploration of authentic problems (Servant-Miklos, 2020). Through PBL, students are trained to identify problems, analyse root causes, discuss collaboratively, and develop innovative solutions based on real data and experiences. Thus, learning does not only emphasise the end result, but also the creative thinking process that occurs during problem solving. Several studies have proven that the application of PBL can increase students' creativity, higher-order thinking skills, and learning independence (Pambudi & Masruroh, 2022; Sitompul, 2021).

In addition, the success of PBL in developing creative thinking skills is greatly influenced by self-efficacy, which is an individual's belief in their ability to complete tasks effectively. Students with high self-efficacy tend to be more confident in facing challenges, more persistent in finding solutions, and more open to new ideas. The application of the Problem-Based Learning (PBL) model also influences students' critical thinking skills, which are influenced by internal factors, namely student motivation to learn. The definition of self-efficacy is the

influence or belief that exists within students that motivates them to engage in the learning process. Learning efficacy can improve the quality of the learning process, whereby students will participate well in the learning process if they have high learning efficacy. High self-efficacy is evident in the capacity to learn, take risks, answer questions, and willingness to take responsibility. The stronger a person's self-efficacy, the better their creative thinking skills. Therefore, self-efficacy has the potential to be an important psychological variable that strengthens the relationship between Problem-Based Learning and students' creative thinking skills.

Based on this description, this study aims to analyse the effect of the problem-based learning model on students' creative thinking abilities, considering the role of self-efficacy as a moderating variable. This study is expected to contribute theoretically to the development of constructivist learning models in the field of entrepreneurship and provide practical implications for lecturers in designing learning that can foster creativity and innovation in students as future entrepreneurs.

METHOD

The selection of research methodology is a crucial step in any research, as it can determine the success of the research. The use of appropriate research methods is very important for a researcher to ensure that their research can answer questions and uncover the truth. Scientific research methods involve collecting data with the aim of describing, proving, developing, and discovering information and theories, as well as understanding, solving, and anticipating human problems (Sugiyono, 2018). In this study, the method used was quasi-experimental. Quasi-experiments are quasi-experimental methods that cannot control all variables that influence the research process.

The research subjects consisted of one experimental class that used the Problem-Based Learning (PBL) model and one control class (comparison) that used the lecture method. To determine the control class and experimental class, this study used purposive sampling. According to Sugiyono (2017), purposive sampling is a data collection technique that involves determining a sample that has been considered. These specific considerations include, for example, people who are considered to know best what we expect, or perhaps those in positions of authority, which will make it easier for researchers to explore the objects and social situations being studied. The researcher selected classes A and B in the seventh semester of the Law study programme at Kuningan University for the 2024/2025 academic year because, based on preliminary studies, the students' creative thinking skills were still relatively low, and each class had the same characteristics and number of students, namely 37 students.

The research design used was a factorial design with the aim of determining the effect of two independent variables on the dependent variable. The first independent variable (treatment variable) was the Problem-Based Learning model, the second independent variable (moderator variable) was learning self-efficacy, and the dependent variable was students' creative thinking skills. The independent variables consist of the Problem-Based Learning model (A1) and the lecture method (A2). The moderator variables consist of strong self-efficacy (B1), moderate self-efficacy (B2), and low self-efficacy (B3). The design can be seen in the following table:

Table 1. Factorial Design

Learning Self-Efficacy	Learning Model	
	Experimental Class Learning Model Problem Based Learning	Control Class Conventional
Strong (B1)	A_1B_1	A_2B_1
Moderate (B2)	A_1B_2	A_2B_2
Low (B3)	A1B3	A2B3

Description

A1 : Group of students given the Problem-Based Learning model as the experimental class
A2 : Group of students given lecture-based learning
B1 : Strong Learning Efficacy (B1)
B2 : Moderate Learning Efficacy (B2)
B3 : Low Learning Efficacy (B3)
A1B1 : Creative thinking ability of students introduced to the Problem-Based Learning model who have high self-efficacy.
A1B2 : Creative thinking ability of students introduced to the lecture method who have high self-efficacy.
A2B1 : Creative thinking abilities of students introduced to the Problem-Based Learning model with moderate self-efficacy.
A2B2 : Creative thinking abilities of students introduced to the lecture method with moderate self-efficacy.
A1B3 : Creative thinking abilities of students introduced to the Problem-Based Learning model with low self-efficacy.
A2B3 : Creative thinking abilities of students introduced to the lecture method with low self-efficacy.

In addition, to determine the groups of students with high, medium and low self-efficacy, a learning self-efficacy questionnaire was used, which was interpreted using the following criteria:

Table 2. Self-Efficacy Level Criteria

No	Self-Efficacy Level	Description
1	$X > X + SD$	High Self-Efficacy
2	$X - SD < x < X + SD$	Moderate Self-Efficacy
3	$x < X - SD$	Low Self-Efficacy

Based on Table 2 above, self-efficacy criteria were used to categorise students according to their level of confidence in their learning abilities. Students with scores higher than the average plus one standard deviation (X>X+SD) were categorised as having high self-efficacy, meaning they were very confident and independent in their learning. Students with scores between the mean minus and plus one standard deviation (X<X<+SD) have moderate self-efficacy, meaning they are reasonably confident but still need support. Meanwhile, students with scores lower than the mean minus one standard deviation (X<X-SD) have low self-efficacy, indicating a lack of confidence in facing learning tasks.

RESULT AND DISCUSSION

Descriptive Pretest

The pretest was administered to two research samples, namely the control class and the experimental class, prior to treatment. The research instrument administered was a written test consisting of 30 questions. Based on the processing of the initial data (pretest) from the control class and the experimental class, the following results were obtained:

Table 3. Results of Pre-test Data Analysis for the Control Class and Experimental Class Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Experimental Pre-test	37	40	73	61,89	10,739
Control Pre-test	37	33	70	59,16	7,171
Valid N (listwise)	37				

Based on the results of the pretest data analysis in Table 3, it can be seen that the number of participants in the experimental class and the control class was 37 students each. The pretest scores in the experimental class ranged from 40 to 73, while in the control class they ranged from 33 to 70. This shows that before the learning treatment was given, the initial abilities of the students in both classes were relatively similar. The average pretest score for the experimental class was 61.89, while the average for the control class was 59.16. The

difference in the average of only 2.73 points indicates that the ability levels of the two groups were fairly balanced. The standard deviation score for the experimental class was 10.73 and for the control class 7.17, indicating that the variation or spread of scores among students in the experimental class was slightly greater than in the control class. Thus, descriptively, it can be concluded that before the treatment was given, both the experimental class and the control class had relatively the same initial abilities, so that the difference in learning outcomes at the post-test stage could be more reliably attributed to the learning treatment applied in the experimental class.

Final Test Description (Posttest)

The final test (Posttest) was administered to two research samples, namely the control class and the experimental class, after the treatment. The research instrument administered was in written form and consisted of 30 questions. Based on the processing of the final results (Posttest) of the control class and the experimental class, the following was obtained:

Table 4. Results of Posttest Data Analysis for the Control Class and Experimental Class Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Experimental Posttest	37	65	90	76,35	8,135
Control Posttest	37	47	75	60,19	7,612
Valid N (listwise)	37				

Based on the results of the post-test data analysis in Table 4, it can be seen that the number of participants in the experimental class and the control class was 37 students each. The post-test scores in the experimental class ranged from 65 to 90, while in the control class they ranged from 47 to 75. This shows that the minimum and maximum scores in the experimental class were higher than those in the control class. The average post-test score for the experimental class was 76.35, while that for the control class was 60.19. The difference in average scores of only 16.16 points indicates that students in the experimental class achieved better learning outcomes than students in the control class after being given different learning treatments. The standard deviation of the experimental class was 8.13 and that of the control class was 7.612, indicating that the distribution of scores among students in both classes was relatively uniform. Although the variation in scores between students was almost the same, the difference in the average scores of students in both classes was relatively uniform. Even though the variation in scores between students was almost the same, the significant difference in scores indicated that the treatment or learning method applied in the experimental class had a positive effect on improving student learning outcomes compared to the method used in the control class.

To determine the improvement in critical thinking skills in the experimental class using the Problem-Based Learning (PBL) model compared to the control class using lecture-based learning, normalised gain was calculated using Hoke's formula. The results of the N-gain data analysis can be seen in the table below.

Table 5. Data Analysis of Creative Thinking Ability Gains in The Experimental Class and Control Class

	N	Postest	N-Gain	Kategori
Experimental Posttest	37	60,19	0.18	Low
Control Posttest	37	76,35	0.41	Medium

From the table, the post-test data in the control class obtained a normalised gain (N-Gain) of 0.18, which is classified as low. Meanwhile, the experimental class obtained a normalised gain (N-Gain) of 0.41, which is classified as moderate. This indicates that there is a difference in

creative thinking ability between classes that use Problem Based Learning (PBL) and those that use lecture-based learning.

Description of Student Self-Efficacy

In this study, researchers used questionnaires to measure the level of self-efficacy of students in the experimental class and control class in the Law Study Programme at Kuningan University in the Entrepreneurship course. The learning self-efficacy questionnaire was given to 74 respondents. Based on the processing of data on learning self-efficacy in the experimental and control classes, the following results were obtained:

Table 6. Learning Motivation Data Results for the Experimental Class and Control Class

	N	Minimum	Maximum	Mean	Std. Deviation
High Self-Efficacy PBL	20	53	60	53,90	1,714
Moderate Self-Efficacy PBL	14	43	52	48,00	3,162
Low Self-Efficacy PBL	3	39	41	40,33	1,155
High Self-Efficacy Lecture	5	53	55	53,80	,837
Moderate Self-Efficacy Lecture	27	43	52	46,56	25,77
Low Self-Efficacy Lecture	5	38		40,80	1,789
Valid N (listwise)	3				

Based on the table above, the control class that used lecture-based learning had 37 students, including 5 students with low self-efficacy, 27 students with moderate self-efficacy, and 5 students with high self-efficacy. Meanwhile, in the experimental class that used the Problem-Based Learning (PBL) model, there were 3 students with low self-efficacy, 14 students with moderate self-efficacy, and 20 students with high self-efficacy.

Hypothesis Testing

After both groups had the same or homogeneous variants, hypothesis testing was then conducted using the Two-Way ANOVA test in the SPSS 23 program. The following is a summary table of the hypothesis testing results using the Two-Way ANOVA test.

Table 7. Hypothesis Test Results

Tests of Between-Subjects Effects

Dependent: Creative Thinking Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4614.700[a]	5	922,940	19,418	,000
Intercept	283223,142	1	283223,142	5958,872	,000
Learning Model	580,832	1	580,832	12,220	,001
Self-Efficacy	1924,368	2	962,184	20,244	,000
Learning Model * Self-Efficacy	3311,512	2	1655,756	34,836	,000
Error	3232,016	68	47,530		
Total	540289,000	74			
Corrected Total	7846,716	73			

a. R Squared = .588 (Adjusted R Squared = .558)

Based on the results of testing the hypothesis, the following conclusions can be drawn:

1) The Problem-Based Learning (PBL) model can improve students' critical thinking skills, as seen from the F value of 12.220 with a significance value of 0.001 < 0.05. An independent variable is said to have an effect on the dependent variable if the significance value is < 0.05. Therefore, the significance value in the first hypothesis is < 0.05, so the hypothesis is accepted. This means that there is a statistical difference in the critical thinking skills of students who use the Problem Based Learning (PBL) model and students who use lecture-based learning.

2) For the second hypothesis, an F value of 20.244 and a significance value of 0.000 < 0.05 were obtained, meaning that the second hypothesis is accepted. This means that the creative thinking abilities of students with low self-efficacy, moderate self-efficacy, and high self-efficacy have statistical differences.
3) For the third hypothesis, a significance value of 0.000 with F 34.836 was obtained. This shows that the significance value for the third hypothesis is < 0.05, meaning that the hypothesis is accepted. This means that there is an interaction between the learning model and students' learning efficacy in influencing students' critical thinking abilities.
4) From the Adjusted R Squared value, a figure of 0.558 was obtained, which means that the two independent variables (students' self-efficacy) and their interaction are able to explain 55.8% of the dependent variable.

Based on the Eta Square (*n*2) calculation and statistical hypotheses, the following conclusions can be drawn:

1) The learning model has a significant effect on students' critical thinking skills, because the calculated F value of 12.220 is greater than the table F value of 3.98.
2) Self-efficacy in learning also has a significant effect on students' critical thinking skills, because the calculated F value of 20.244 is greater than the table F value of 3.12.
3) There is a significant interaction between the learning model and self-efficacy on students' critical thinking skills, because the calculated F value of 34.836 is greater than the table F value of 3.98.

DISCUSSION

The main finding of this study demonstrates that there was no statistically significant difference in students' initial creative thinking abilities between the experimental and control groups prior to the intervention. This finding strengthens the internal validity of the study and ensures that the subsequent improvement can be attributed to the instructional treatment rather than pre-existing differences. Notably, several prior studies investigating the impact of Problem-Based Learning (PBL) have not explicitly reported baseline equivalence in creative thinking skills, particularly in meta-analytic syntheses such as those conducted by Lamb et al. and Ulger (Ulger, 2018; Lamb et al., 2018). By statistically confirming homogeneity at the outset, this study provides a more rigorous experimental foundation for interpreting the observed gains.

Consistent with a substantial body of literature, the findings indicate that the implementation of PBL significantly enhanced students' creative thinking skills. This result aligns with the conclusions of Carroll et al., who reported that embedding creative pedagogy within PBL environments fosters higher-order cognitive engagement (Carroll et al., 2020). Similarly, Lamb et al. (2018) identified a moderate but statistically significant overall effect of PBL on creativity across diverse educational contexts (Lamb et al., 2018). The present findings corroborate these results and reinforce the theoretical proposition that authentic problem-solving contexts stimulate divergent thinking processes.

However, this study differs from many previous investigations in several important respects. First, whereas earlier research frequently conceptualized creativity as one component within broader constructs such as higher-order thinking skills or 21st-century competencies (e.g., Harris & Bruin, 2018; Wiyanto, 2020). The current study positions creative thinking as the primary dependent variable. This conceptual specificity allows for a clearer examination of PBL's direct contribution to creativity, rather than conflating it with adjacent cognitive outcomes.

Second, most empirical studies on PBL effectiveness have been conducted in science, or interdisciplinary settings. For instance, Burgin & Burgin highlighted variability in PBL outcomes depending on disciplinary focus and assessment approaches. In contrast, the present research contributes to the relatively limited body of evidence within economics education. By situating PBL in an economics classroom context, this study extends the applicability of constructivist learning theory beyond traditionally examined domains and suggests that creativity enhancement through PBL is not discipline-bound.

Third, while prior meta-analyses e.g., Ulger; Lamb et al. emphasize that instructional design variables and contextual moderators influence the magnitude of PBL's effects, the present findings demonstrate that even under controlled classroom conditions with

homogeneous initial abilities, PBL yields significant improvements (Lamb et al., 2018; Ulger, 2018). This strengthens the argument that the model itself—when implemented with fidelity—plays a decisive role in stimulating fluency, flexibility, originality, and elaboration in students' thinking processes.

Furthermore, some studies have reported that the effectiveness of PBL varies depending on evaluation techniques and moderating factors (Burgin & Burgin, 2020; Thornberg et al., 2020; Tao et al., 2022). In contrast, the present study employed structured indicators of creative thinking and demonstrated consistent improvement across measured dimensions. This suggests that well-defined creativity rubrics may reduce measurement variability and provide more stable evidence of instructional impact.

In sum, while the general trend in the literature supports the positive influence of PBL on creative thinking, this study contributes novel insights by: (1) establishing baseline equivalence prior to intervention, (2) isolating creativity as the principal outcome variable, (3) situating the investigation within economics education, and (4) providing controlled experimental evidence at the classroom level. These distinctions enhance the theoretical precision and contextual breadth of existing PBL scholarship and suggest avenues for future research examining disciplinary adaptations and longitudinal sustainability of creativity gains.

The novelty of this study lies in its focus on enhancing creativity as the primary outcome. Many previous studies have employed a combination of indicators such as critical thinking, collaboration, and literacy within a single framework. In contrast, this study identifies creativity as the main outcome variable. This approach clarifies the specific contribution of Problem-Based Learning (PBL) to the development of creative thinking skills, rather than positioning it merely as part of multiple skill outcomes.

This study makes a significant methodological and theoretical contribution to the literature on Problem-Based Learning (PBL) and creative thinking by strengthening causal inference and conceptual clarity. Unlike prior meta-analyses that synthesize broad effect sizes without consistently emphasizing baseline equivalence, the present research explicitly confirms the statistical homogeneity of students' initial creative thinking abilities prior to intervention. By doing so, it enhances internal validity and reduces alternative explanations related to pre-existing cognitive differences. Moreover, whereas previous studies often positioned creativity as a subdimension of higher-order thinking or 21st-century competencies (e.g., Harris & Bruin, 2018; Wiyanto, 2020), this study isolates creative thinking as the primary dependent variable. This conceptual precision advances theoretical understanding by demonstrating that PBL exerts a direct and measurable influence on creativity itself—particularly on fluency, flexibility, originality, and elaboration—rather than merely contributing to aggregated cognitive constructs.

In addition, this research contributes contextually by extending empirical validation of PBL's effectiveness into economics education, a disciplinary setting less represented in creativity-focused PBL scholarship. Prior empirical work has predominantly concentrated on STEM or interdisciplinary domains and has highlighted variability in outcomes due to disciplinary and assessment differences (Burgin & Burgin, 2020; Thornberg et al., 2020; Tao et al., 2022). By demonstrating consistent improvements using structured creativity indicators within a controlled classroom environment, the present study provides evidence that PBL's creativity-enhancing mechanisms are transferable across disciplinary contexts. Furthermore, by addressing concerns regarding moderating instructional and evaluative variables (Thornberg et al., 2020), this study shows that implementation fidelity and clearly operationalized creativity rubrics can reduce measurement variability and strengthen outcome stability. Consequently, the research refines the theoretical and contextual boundaries of PBL scholarship and offers a more robust empirical basis for future investigations into longitudinal effects and cross-disciplinary applications.

First Theoritical Implications, the current findings refine constructivist and interactionist accounts of creativity by showing that PBL's effects on divergent thinking operate through structured problem complexity and facilitative scaffolding rather than mere exposure to problems. This aligns with process-focused work on creative problem solving that

emphasizes staged cognitive operations problem understanding, idea generation, preparation for action and shows these processes are observable and measurable in classroom contexts (Hooijdonk et al., 2023). By demonstrating significant gains in fluency, flexibility, originality, and elaboration even when baseline creative ability is equivalent across groups, the study supports a mechanism view in which pedagogical design (task structure + facilitator moves) is the proximal cause of creative gains rather than broad learner characteristics alone (Guilford, 1950; Bai et al., 2021; Kuo et al., 2019; Ulger, 2018). These results therefore encourage theoretical models to treat pedagogy as an active component in creativity models (i.e., pedagogy × cognition interaction), not merely as background context.

Practical Implications for instructional designers and teachers, the findings recommend (a) building PBL scenarios with graded ill-structuredness (to stimulate idea generation and refinement), (b) embedding explicit scaffolds for divergent thinking (e.g., idea fluency prompts, perspective-shifting cues), and (c) training facilitators in targeted questioning moves. Empirical studies of PBL and creative pedagogy corroborate that when PBL tasks are deliberately sequenced and combined with creativity prompts, student creative outputs and process behaviors increase (Kuo et al., 2024; Kim et al., 2019). Practically, this means lesson plans should include clear creativity rubrics (fluency, flexibility, originality, elaboration) and formative checkpoints so instructors can scaffold iteratively rather than leaving creativity to chance.

At the curriculum and assessment level, institutions should align learning outcomes and assessment frameworks to reward creative processes as well as products. Meta-analytic evidence indicates variable effects of problem-driven learning partly because traditional assessment systems privilege convergent answers and penalize risk-taking (Wijnia et al., 2024). To sustain creativity gains observed under PBL, departments (including economics) should incorporate alternative assessment formats portfolio tasks, judged open-ended solutions, peer review, and process logs that explicitly value originality and elaboration. Doing so helps institutionalize creative pedagogy: when assessment, teacher training, and instructional materials are co-designed around PBL principles, creative thinking becomes a measurable, reportable competency rather than an incidental by-product.

Despite its contributions, this study has several limitations that should be acknowledged. First, although the experimental design established baseline equivalence between groups, the research was conducted within a single institutional and disciplinary context namely, economics education in one school setting. This limits the generalizability of the findings across different educational levels, cultural contexts, or subject domains. Prior research has shown that the effectiveness of PBL may vary depending on disciplinary epistemology and classroom ecology (e.g., Burgin & Burgin, 2020; Wijnia et al., 2024). Therefore, the extent to which the present results can be extrapolated to other subjects or broader populations remains uncertain. Multi-site or cross-disciplinary replications would be necessary to strengthen external validity.

Second, the duration of the intervention was relatively limited and did not allow for examination of long-term retention or sustainability of creativity gains. While short-term improvements in fluency, flexibility, originality, and elaboration were observed, creativity development is widely understood as a longitudinal cognitive process influenced by sustained practice and iterative feedback. Without follow-up measurement, it is unclear whether the observed gains represent enduring cognitive transformation or temporary performance effects. Future longitudinal designs could address this gap by incorporating delayed post-tests or tracking creative performance across semesters.

Third, although structured creativity rubrics were employed to reduce measurement variability, the study relied primarily on performance-based assessment within a classroom context. Creativity assessment inherently involves subjective judgment, even when guided by validated indicators. Differences in scoring interpretation, rater bias, or contextual framing of tasks may still influence outcomes. Additionally, the study did not incorporate complementary qualitative data (e.g., student reflections or observational protocols) that might have enriched understanding of the creative processes activated during PBL implementation. Integrating

mixed-method approaches could provide deeper insight into how and why PBL stimulates creative cognition.

Finally, while the study emphasizes instructional fidelity, it does not fully disentangle which specific elements of PBL (e.g., problem authenticity, collaborative discussion, teacher scaffolding) contributed most strongly to the observed improvements. Meta-analytic evidence suggests that instructional design features act as moderating variables in PBL effectiveness (Lamb et al., 2018; Ulger, 2018). However, the present design treated PBL as a unified intervention rather than decomposing its active components. Future experimental research employing component analysis or mediation modeling would help clarify the mechanisms underlying creativity enhancement.

Building upon the identified limitations, future research should expand the contextual and methodological scope of PBL investigations in creativity development. Multi-site studies across different schools, regions, and educational levels would enhance external validity and allow comparative analysis of disciplinary effects. Given that prior meta-analytic work highlights variability in PBL outcomes across domains and instructional conditions future studies should employ cross-disciplinary designs to examine whether creativity gains differ between economics, and humanities contexts. Additionally, incorporating larger and more diverse samples would improve statistical power and strengthen the generalizability of findings.

Longitudinal and mechanism-focused research is also needed to determine the sustainability and underlying processes of creativity enhancement through PBL. While short-term gains were observed in the present study, future research should include delayed post-tests to assess retention and long-term cognitive transformation. Moreover, experimental designs that isolate specific components of PBL, such as problem authenticity, collaborative interaction, scaffolding intensity, or assessment structure would clarify which elements most strongly drive creativity development. As suggested by prior syntheses, instructional variables function as moderating factors; therefore, mediation or structural equation modeling approaches could provide deeper insight into causal pathways. Integrating mixed-method approaches, including qualitative observations and student reflective narratives, would further illuminate how learners experience and internalize creative problem-solving processes within PBL environments.

CONCLUSION

This study provides robust empirical evidence that Problem-Based Learning (PBL) significantly enhances students' creative thinking skills when implemented with methodological rigor and instructional fidelity. By establishing baseline equivalence between experimental and control groups prior to intervention, the study strengthens causal inference and ensures that observed gains can be attributed to the instructional model rather than pre-existing differences. Consistent with prior syntheses reporting positive yet heterogeneous effects of PBL (Lamb et al., 2018; Ulger, 2018), the findings confirm that authentic, ill-structured problem contexts stimulate measurable improvements in fluency, flexibility, originality, and elaboration. However, unlike many previous investigations that subsume creativity within broader higher-order thinking constructs, this study isolates creative thinking as the primary outcome variable, thereby enhancing conceptual precision and theoretical clarity.

Beyond corroborating existing literature, this research advances PBL scholarship in three meaningful ways. First, it contributes methodological rigor through controlled experimental validation. Second, it extends the empirical boundary of PBL effectiveness into economics education a disciplinary context less frequently examined in creativity research—supporting the transferability of PBL's cognitive benefits (Burgin & Burgin, 2020; Wijnia et al., 2024). Third, by employing structured creativity indicators and demonstrating consistent improvements across dimensions, the study offers a more stable measurement framework that may reduce variability associated with instructional and evaluative moderators.

At the same time, the study acknowledges contextual and methodological constraints, including limited generalizability, short intervention duration, and the absence of component-

level analysis within the PBL model. These limitations open important avenues for future research, particularly longitudinal investigations and mechanism-focused experimental designs that disentangle the relative contribution of scaffolding, collaboration, and task authenticity. Such extensions would further refine theoretical models explaining how PBL activates creative cognition and would clarify the sustainability of its effects.

In sum, this research reinforces the position of PBL not merely as an alternative instructional strategy but as a theoretically grounded and empirically validated approach to cultivating creative thinking within formal education. By integrating rigorous experimental design, disciplinary expansion, and conceptual specificity, the study offers high-impact contributions to the fields of educational psychology and instructional innovation. It provides a strengthened empirical foundation for advancing creativity-oriented pedagogy and invites future scholarship to explore cross-disciplinary adaptation, long-term sustainability, and deeper causal mechanisms underlying creative learning processes.

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AUTHOR CONTRIBUTION STATEMENT

IY was responsible for developing the article concept, writing the research methods, and analysing all data. HR was responsible for improving the writing of the article, interpreting the findings, and presenting conclusions and recommendations. IM was responsible for revising the article and proofreading the entire text and language of the article.

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