

ANALYSIS OF THE RELATIONSHIP BETWEEN THE IMPLEMENTATION OF PROJECT-BASED LEARNING (PJBL) THROUGH A BIOENTREPRENEURSHIP EXHIBITION AND STUDENTS' ENTREPRENEURIAL MINDSET AND ENTREPRENEURIAL CREATIVITY

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Abstract: *Analysis of the Relationship between the Implementation of Project-Based Learning (PjBL) through a Bioentrepreneurship Exhibition and Students' Entrepreneurial Mindset and Entrepreneurial Creativity*

This study examined students' perceptions of the implementation of Project-Based Learning (PjBL) through a bioentrepreneurship exhibition and its relationship with entrepreneurial mindset and entrepreneurial creativity among students in the Biology Education Study Program at UIN Alauddin Makassar. The study employed an ex post facto design with a quantitative approach. The population comprised students from the fourth to seventh semesters, while the sample consisted of 76 students from the 2021 cohort selected through purposive sampling. Data were collected using three instruments: an entrepreneurial mindset questionnaire adapted from Cui et al. (2021) and Sun et al. (2023), an entrepreneurial creativity questionnaire adapted from (Ahlin et al., 2014), and a questionnaire measuring students' perceptions of PjBL implementation based on the PjBL syntax. The data were analyzed using Spearman's rank correlation test. The findings revealed that students' perceptions of PjBL implementation were positively and significantly associated with entrepreneurial mindset. Students' perceptions of PjBL implementation were also positively and significantly associated with entrepreneurial creativity, representing the strongest relationship among the examined variables. In addition, entrepreneurial mindset showed a positive and significant relationship with entrepreneurial creativity. These findings indicate that the implementation of PjBL through a bioentrepreneurship exhibition is meaningfully associated with the development of students' entrepreneurial mindset and entrepreneurial creativity. The study underscores the potential of exhibition-based PjBL as a pedagogical strategy for strengthening entrepreneurial orientation and competencies in biology education.

Keywords: *Bioentrepreneurship, Entrepreneurial Creativity, Entrepreneurial Mindset, Project-Based Learning, Student Entrepreneurship.*

Abstrak: Analisis Hubungan antara Implementasi Pembelajaran Berbasis Proyek (PjBL) melalui Pameran Bioentrepreneurship dan Pola Pikir Kewirausahaan serta Kreativitas Kewirausahaan Mahasiswa

Studi ini meneliti persepsi mahasiswa terhadap implementasi Pembelajaran Berbasis Proyek (PjBL) melalui pameran bioentrepreneurship dan hubungannya dengan pola pikir kewirausahaan serta kreativitas kewirausahaan di kalangan mahasiswa Program Studi Pendidikan Biologi di UIN Alauddin Makassar. Studi ini menggunakan desain *ex post facto* dengan pendekatan kuantitatif. Populasi terdiri dari mahasiswa semester empat hingga tujuh, sedangkan sampel terdiri dari 76 mahasiswa angkatan 2021 yang dipilih melalui purposive sampling. Data dikumpulkan menggunakan tiga instrumen: kuesioner pola pikir kewirausahaan yang diadaptasi dari Cui et al. (2021) dan Sun et al. (2023), kuesioner kreativitas kewirausahaan yang diadaptasi dari Ahlin et al., (2014), dan kuesioner yang mengukur persepsi mahasiswa terhadap implementasi PjBL berdasarkan sintaks PjBL. Data dianalisis menggunakan uji korelasi peringkat Spearman. Temuan menunjukkan bahwa persepsi mahasiswa terhadap implementasi PjBL berhubungan positif dan signifikan dengan pola pikir kewirausahaan. Persepsi mahasiswa terhadap implementasi PjBL juga berhubungan positif dan signifikan dengan kreativitas kewirausahaan, yang merupakan hubungan terkuat di antara variabel yang diteliti. Selain itu, pola pikir kewirausahaan menunjukkan hubungan positif dan signifikan dengan kreativitas kewirausahaan. Temuan ini menunjukkan bahwa implementasi PjBL melalui pameran bioentrepreneurship secara bermakna berhubungan dengan pengembangan pola pikir kewirausahaan dan kreativitas kewirausahaan mahasiswa. Studi ini menggarisbawahi potensi PjBL berbasis pameran sebagai strategi pedagogis untuk memperkuat orientasi dan kompetensi kewirausahaan dalam pendidikan biologi.

Kata kunci: Bioentrepreneurship, Kreativitas Kewirausahaan, Pola Pikir Kewirausahaan, Pembelajaran Berbasis Proyek, Kewirausahaan Mahasiswa.

INTRODUCTION

Higher education plays a strategic role in developing human capital that not only demonstrates academic excellence but also possesses creative, adaptive, innovative, and highly competitive thinking skills. In the current era of globalization and technological disruption, graduate success is no longer determined solely by cognitive competence, but also by entrepreneurial mindset and entrepreneurial creativity, which enable individuals to recognize opportunities, generate innovation, and create value amid uncertainty (Degefu et al., 2024; Khuong & Nguyen, 2023).

Entrepreneurial mindset refers to a way of thinking characterized by proactiveness, innovativeness, a willingness to take calculated risks, and resilience in responding to challenges (Cui et al., 2021). Entrepreneurial creativity, in turn, refers to the ability to generate novel ideas that are original, relevant, and capable

of producing economic or social value (Ahlin et al., 2014). These two constructs are closely interrelated and provide an important foundation for students as they prepare to navigate an increasingly competitive and dynamic labor market.

Empirical conditions indicate that many university students in Indonesia remain oriented toward becoming job seekers rather than job creators. Data from Statistics Indonesia (BPS, 2023) show that the open unemployment rate among higher education graduates reached 7.99%, the highest compared with graduates from other educational levels. This condition reflects a gap between higher education outcomes and labor market demands, as well as the limited development of entrepreneurial mindset and entrepreneurial creativity among university students.

In biology education, students tend to focus on pedagogical and theoretical competencies, while biology-based entrepreneurial competencies, such as applied biotechnology, environmental conservation, and eco-friendly product innovation, still receive limited attention. Preliminary interviews with 20 students from the Biology Education Study Program at UIN Alauddin Makassar regarding career orientation and career interests showed that 14 students (70%) still oriented themselves toward becoming teachers, whereas only 6 students (30%) expressed an interest in entrepreneurship in the field of biology. These initial findings indicate that students' entrepreneurial orientation remains relatively low. Therefore, more contextual learning experiences are needed to connect biological theory with authentic entrepreneurial practice.

One relevant and effective approach is Project-Based Learning (PjBL). PjBL positions students as active learners who construct knowledge through the design and implementation of real-world projects that are relevant to everyday life (Wiyono et al., 2025). This model emphasizes the application of knowledge through collaborative, exploratory, and reflective activities that require students to think creatively and innovatively while taking responsibility for their learning outcomes.

In the context of biology education, PjBL can be implemented through a Bioentrepreneurship Exhibition, an activity in which students design, produce, and present innovative biology-based products that have economic, ecological, and educational value. The Bioentrepreneurship Exhibition serves not only as a platform for appreciating learning outcomes but also as a means of applying PjBL principles in an authentic context. The PjBL syntax consists of six stages: (1) identifying a driving question, (2) designing the project, (3) developing a schedule, (4) monitoring progress, (5) testing the product, and (6) evaluating the learning experience (Santoso et al., 2023). Through this exhibition, students have opportunities to integrate biological theory with entrepreneurial practice, develop creative ideas, innovate products, and strengthen their communication and collaboration skills.

The implementation of PjBL through a Bioentrepreneurship Exhibition also aligns with experiential learning, as students learn through direct experience in

designing, producing, and presenting marketable products. This activity encourages students to think critically, work collaboratively, and reflect on the processes they have undertaken. The products developed may include simple biotechnology products, biology-based digital learning materials, organic products, or other environmentally friendly innovations with commercial potential. Thus, the exhibition functions not only as a venue for showcasing student work but also as a learning medium that fosters students' entrepreneurial mindset and entrepreneurial creativity.

Shahiwala (2017) reported that project-based learning can enhance creativity and managerial skills among pharmacy students. Santoso et al. (2023) through Project-Based Entrepreneurial Learning (PBEL), found that real-world projects can stimulate the emergence of startup ideas and business innovations in campus environments. Similarly, Wiyono et al. (2025) demonstrated that constructivist-oriented PjBL improves students' entrepreneurial competencies, particularly in creativity, reflection, and authentic assessment.

Entrepreneurial mindset and entrepreneurial creativity tend to develop more effectively through practical activities, such as exhibitions, collaborative projects, and inspirational experiences, rather than through theoretical instruction alone (Cui et al., 2021). Entrepreneurial creativity includes the ability to generate original ideas with economic value, solve problems innovatively, and transform knowledge into sustainable business opportunities.

PjBL-based Bioentrepreneurship Exhibition activities may serve as an effective medium for developing these two dimensions simultaneously. Based on this rationale, this study aims to examine: (1) the relationship between students' perceptions of the implementation of Project-Based Learning (PjBL) through a Bioentrepreneurship Exhibition and the entrepreneurial mindset of students in the Biology Education Study Program at UIN Alauddin Makassar; (2) the relationship between students' perceptions of the implementation of PjBL through a Bioentrepreneurship Exhibition and their entrepreneurial creativity; and (3) the relationship between students' entrepreneurial mindset and entrepreneurial creativity.

RESEARCH METHOD

This study employed an ex post facto research design with a quantitative approach. Ex post facto research examines possible causal relationships after an event or phenomenon has occurred, without any intervention or manipulation by the researcher (Dhenge et al., 2022). In this design, the researcher observes existing dependent variables and seeks to identify their possible associations with independent variables that have occurred previously. The study was conducted at Universitas Islam Negeri Alauddin Makassar from September to November 2025.

The population consisted of 120 fourth to seventh semester students enrolled in the Biology Education Study Program at UIN Alauddin Makassar. The sample comprised 76 students from the 2021 cohort of the Biology Education Study Program. Two classes were selected using purposive sampling. This technique was chosen because the sample possessed specific characteristics required to address the research questions, rather than to achieve statistical generalization.

Data were collected using three research instruments. Entrepreneurial mindset was measured using a questionnaire adapted from Cui et al. (2021), and Sun et al. (2023), Entrepreneurial creativity was measured using a questionnaire adapted from Ahlin et al. (2014). Students' perceptions of PjBL implementation were measured using a questionnaire developed based on the PjBL syntax. The data collection procedure consisted of three stages: preparation, implementation, and data processing.

The data were analyzed using correlation analysis to examine the strength and direction of the relationships among students' perceptions of PjBL implementation, entrepreneurial mindset, and entrepreneurial creativity. This analysis was used to address the research objectives concerning the relationships among the specified variables.

RESULTS AND DISCUSSION

This section presents the research findings, including descriptive and inferential analyses of the study variables: students' perceptions of PjBL through the Bioentrepreneurship Exhibition, entrepreneurial mindset, and entrepreneurial creativity. Descriptive analysis was conducted to provide an overview of the data distribution before further statistical testing. The descriptive statistics for the three variables are presented in Table 1.

Table 1. Results of Descriptive Analysis

Statistic	PjBL Perception	<i>Entrepreneurial Mindset</i>	Entrepreneurial Creativity
Sample size	76	76	76
Mean	93.72	85.82	42.96
Median	96.00	88.50	44.00
Std. Deviation	7.012	8.148	4.771
Variance	49.163	66.392	22.758
Minimum	60	61	30
Maximum	100	94	50

Sumber: Data diolah peneliti, 2026

Table 1 shows that, among the 76 respondents, the mean score for students' perceptions of PjBL through the Bioentrepreneurship Exhibition was 93.72 out of an ideal score of 100, indicating a very high category with a relatively consistent distribution of scores ($SD = 7.012$). The mean score for entrepreneurial mindset was 85.82 out of an ideal score of 95, indicating that respondents' entrepreneurial

mindset was in the high category, with moderate variation in the data ($SD = 8.148$). Meanwhile, the mean score for entrepreneurial creativity was 42.96 out of an ideal score of 50, indicating that respondents' creativity was also in the high category. The lowest standard deviation ($SD = 4.771$) indicates that entrepreneurial creativity scores were the most homogeneous among the three variables. Overall, the descriptive findings indicate high and relatively consistent scores across all variables examined in this study.

Inferential statistical analysis was then conducted through assumption testing and hypothesis testing to examine the relationships among the research variables. This analysis was used to draw more comprehensive conclusions regarding the relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition and their entrepreneurial mindset and entrepreneurial creativity. Before conducting the main analysis, a normality test was performed to determine whether the data met the assumptions required for parametric analysis. The results of the normality test are presented in Table 2.

Table 2. Results of the Normality Test

Variable	Asymp. Sig. (2-tailed)
PjBL through the Bioentrepreneurship Exhibition	0,001
Entrepreneurial Mindset	0,001
Entrepreneurial Creativity	0,180

Source: Research data processed by authors, 2026

Table 2 presents the results of the One-Sample Kolmogorov-Smirnov Test for the three research variables. Based on the Asymp. Sig. (2-tailed) values, PjBL through the Bioentrepreneurship Exhibition and entrepreneurial mindset each obtained a significance value of 0.001, which is lower than the threshold value of $\alpha = 0.05$. This result indicates that both variables were not normally distributed. In contrast, entrepreneurial creativity obtained a significance value of 0.180, which is greater than 0.05, indicating that this variable was normally distributed. Therefore, subsequent analysis needed to consider the distributional characteristics of the data, particularly by applying nonparametric analysis for variables that did not meet the normality assumption.

Table 3. Results of Hypothesis Testing

Variable		PjBL Perception	Entrepreneurial Mindset	Entrepreneurial Creativity
PjBL Perception	Correlation coefficient	1,000	0,402	0,464
	Sig. (2-tailed)	0,000	<.001	<.001
Entrepreneurial Mindset	Correlation coefficient	0,402	1,000	0,358
	Sig. (2-tailed)	<.001	0,000	0,001
Entrepreneurial Creativity	Correlation coefficient	0,464	0,358	1,000
	Sig. (2-tailed)	<.001	0,001	0,000

Source: Researcher Processed Data, 2026

Based on the assumption testing, the analysis showed that normal distribution was found only in the data involving Y1 and Y2. Therefore, hypothesis testing was conducted using a nonparametric test, namely Spearman's rank correlation. The results of hypothesis testing are presented in Table 3.

The interpretation of the strength of Spearman's rho correlation coefficient, based on (Papageorgiou, 2022), is presented in Table 4.

Table 4. Interpretation of the Strength of ρ Values

ρ Value	Strength of Relationship
$\pm 0.80 - \pm 1$	Very strong
$\pm 0.60 - \pm 0.799$	Strong
$\pm 0.40 - \pm 0.599$	Moderate
$\pm 0.20 - \pm 0.399$	Weak
$\pm 0.00 - \pm 0.199$	Very weak or negligible

Source: Researcher Processed Data, 2026

The results of hypothesis testing using Spearman's correlation showed a significant relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition (X) and entrepreneurial mindset scores (Y1). The correlation coefficient was $\rho = 0.402$, with a probability value lower than the significance threshold of 0.05. Thus, the hypothesis indicating a relationship between these variables was supported. The coefficient value of $\rho = 0.402$ indicates a positive relationship with moderate strength. This finding suggests that students who perceived PjBL through the Bioentrepreneurship Exhibition more positively tended to demonstrate higher entrepreneurial mindset scores.

The results also showed a significant relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition (X) and entrepreneurial creativity scores (Y2). The correlation coefficient was $\rho = 0.464$, with a probability value below 0.05. Therefore, the hypothesis indicating a relationship between these variables was supported. With a coefficient value of $\rho = 0.464$, this relationship was positive and moderate in strength. This was the strongest correlation among the three variable pairs examined. Practically, more positive perceptions of PjBL through the Bioentrepreneurship Exhibition were associated with higher levels of students' entrepreneurial creativity.

The relationship between entrepreneurial mindset scores (Y1) and entrepreneurial creativity scores (Y2) also showed a significant result. The correlation coefficient was $\rho = 0.358$, with a probability value of 0.001. Since the probability value was lower than the significance threshold of 0.05, the relationship was statistically significant. The coefficient value of $\rho = 0.358$ indicates a positive relationship with weak to moderate strength. Therefore, a positive entrepreneurial mindset was significantly and positively associated with students' entrepreneurial creativity.

Overall, the Spearman correlation analysis involving 76 respondents showed that all variables had significant and positive associations at the $\alpha = 0.01$ significance level. The strongest relationship was found between students' perceptions of PjBL through the Bioentrepreneurship Exhibition (X) and entrepreneurial creativity (Y2), with $\rho = 0.464$, indicating a moderate relationship. The relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition (X) and entrepreneurial mindset (Y1) was also significant and moderate in strength ($\rho = 0.402$). Similarly, the relationship between entrepreneurial mindset (Y1) and entrepreneurial creativity (Y2) was significant, with a weak to moderate strength ($\rho = 0.358$). These findings indicate that positive perceptions of PjBL through the Bioentrepreneurship Exhibition, both directly and in relation to entrepreneurial mindset, had a significant positive association with students' entrepreneurial creativity.

The Relationship between Students' Perceptions of PjBL through the Bioentrepreneurship Exhibition and Entrepreneurial Mindset

The Spearman correlation analysis showed that the relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition and entrepreneurial mindset was in the moderate category, with $\rho = 0.402$ and $p = 0.001$. A moderate correlation indicates that students' perceptions of PjBL did not act as the sole or dominant factor shaping entrepreneurial mindset, but they still contributed meaningfully to its development. In this study, the moderate correlation suggests that positive perceptions of PjBL experiences served as one supporting factor in the development of entrepreneurial mindset, although they were not the only determinant. In other words, the relationship reflects a consistent tendency: students who perceived PjBL more positively also tended to show stronger entrepreneurial orientation, although the increase was not very strong.

The positive moderate correlation of $\rho = 0.402$ also suggests that students' perceptions of PjBL through the Bioentrepreneurship Exhibition contributed in a relatively stable manner, but did not fully determine the level of entrepreneurial mindset. Entrepreneurial mindset is a multidimensional construct shaped by various factors, including life experience, social support, intrinsic motivation, and exposure to entrepreneurial activities outside the classroom. Therefore, a moderate correlation reflects a realistic condition that aligns with the complex nature of entrepreneurial mindset. Nevertheless, because the relationship was positive and significant, PjBL through the Bioentrepreneurship Exhibition clearly contributed to the way students developed innovative thinking, willingness to take calculated risks, and problem-solving orientation similar to that of entrepreneurs.

This finding aligns with several previous studies, Santoso et al. (2023) explained that Project-Based Entrepreneurial Learning can develop students' entrepreneurial competencies and mindset through active involvement in

innovation projects, problem-solving activities, and product design. Engagement in these processes enables students to develop a visionary mindset, stronger self-confidence, and the ability to identify opportunities. This explanation is consistent with the present findings, in which positive perceptions of PjBL through the Bioentrepreneurship Exhibition were associated with stronger entrepreneurial mindset among students. Thus, the moderate relationship found in this study indicates that, although PjBL was not the dominant factor, the Bioentrepreneurship Exhibition still made a meaningful contribution.

Pinto & J (2021) also emphasized that project-based learning provides a conducive learning environment for cultivating entrepreneurial values, including initiative, creativity, and the ability to evaluate risk. This occurs because project-based tasks require students to make decisions, collaborate, and design solutions to authentic problems. This explanation closely reflects the context of the present study, where students who perceived PjBL through the Bioentrepreneurship Exhibition as relevant and meaningful tended to demonstrate a stronger entrepreneurial mindset.

Masdarini et al. (2024) similarly found that students' entrepreneurial readiness and mindset increased when they engaged in challenging project-based learning experiences that provided space for innovation. Such direct experiences help develop self-efficacy, self-confidence, and decision-making ability in business planning contexts. In the present study, the moderate relationship indicates that perceptions of the quality of PjBL implementation through the Bioentrepreneurship Exhibition contributed to entrepreneurial mindset, while other factors, including internal student characteristics and experiences outside campus, also played a role.

In the domain of entrepreneurial mindset, Cui et al. (2021) and Sun et al. (2023) showed that mindset develops through exposure to learning experiences that require creativity, inspiration, and cognitive flexibility. PjBL, as an experiential learning model, can create these conditions. Therefore, the moderate yet positive relationship found in this study can be understood as evidence that PjBL through the Bioentrepreneurship Exhibition contributed to the development of students' cognitive and affective dimensions related to entrepreneurship, although this contribution was also shaped by other factors such as personal motivation, family environment, and prior exposure to entrepreneurial activities.

Although the correlation was moderate, the relationship remains important. PjBL through the Bioentrepreneurship Exhibition consistently supported the development of entrepreneurial mindset. The moderate correlation indicates that this learning model was not the only factor, but it represented a significant factor in the development of students' entrepreneurial thinking. This finding has important pedagogical implications for educators, particularly the need to improve the quality of PjBL design through authentic projects, industry integration, and structured

opportunities for reflection, so that its contribution to entrepreneurial mindset becomes stronger and more optimal.

The Relationship between Students' Perceptions of PjBL through the Bioentrepreneurship Exhibition and Entrepreneurial Creativity

The Spearman correlation analysis showed a significant relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition as variable X and entrepreneurial creativity scores as variable Y2. The correlation coefficient was $\rho = 0.464$, with a significance value of 0.001, indicating a positive relationship of moderate strength. Substantively, this moderate correlation means that students who perceived their PjBL experience through the Bioentrepreneurship Exhibition more positively tended to demonstrate higher levels of entrepreneurial creativity. However, this relationship did not explain all variation in creativity, which suggests that other factors beyond perceptions of PjBL also contributed to the formation of students' entrepreneurial creativity. Notably, this correlation was the strongest among the three variable pairs tested, indicating that creativity was the dimension most responsive to the quality of students' PjBL experience through the Bioentrepreneurship Exhibition.

The moderate correlation coefficient of $\rho = 0.464$ can be interpreted as a fairly substantial and consistent, but not exclusive, association in explaining variation in entrepreneurial creativity. Positive perceptions of PjBL through the Bioentrepreneurship Exhibition contributed to students' ability to generate new product ideas, modify existing products, identify new approaches to packaging and promotion, and combine biological knowledge with business opportunities. At the same time, entrepreneurial creativity is also shaped by personal interest in business, family entrepreneurial background, campus support, access to entrepreneurial communities, and self-efficacy. This interpretation aligns with Ahlin et al. (2014), who showed that entrepreneurial creativity is an important prerequisite for firm innovation, but not the only determinant, because its role is moderated by entrepreneurs' self-confidence in small business contexts. Thus, the moderate but significant correlation found in this study indicates that exhibition-based Bioentrepreneurship PjBL functions as one important factor.

Pedagogically, this finding can be explained by the characteristics of PjBL through the Bioentrepreneurship Exhibition, which positions students as project designers and implementers. In the exhibition activity, students needed to develop biology-based product ideas, conduct trials, improve product form and function, consider usefulness, uniqueness, and competitiveness, and determine how to present and market their products to visitors. These activities align with the essence of entrepreneurial creativity, which involves generating valuable new ideas, identifying opportunities from limited resources, and attempting unconventional solutions. This explanation is consistent with Artayasa et al. (2024), who found that

project-based learning significantly improved students' entrepreneurial creativity compared with conventional science instruction because students engaged in projects that resulted in creative and marketable products. Therefore, the moderate correlation coefficient in the present study can be interpreted as a meaningful and realistic effect of biopreneurship project experiences on the development of entrepreneurial creativity.

The findings also align with studies on project-based entrepreneurship learning in other contexts. Santoso et al. (2023) reported that Project-Based Entrepreneurial Learning encouraged students to produce prototypes and business products and facilitated the emergence of startups, indicating that business-oriented project tasks enriched students' creative experiences in designing and testing business ideas. In the present study, the Bioentrepreneurship Exhibition played a similar role as an authentic arena that challenged students to formulate ideas, test feasibility, and creatively present biology-based products.

From the perspective of creativity theory and entrepreneurship education, several studies support the positive relationship found in this study. The effectiveness of entrepreneurship education has a strong positive correlation with entrepreneurial creativity, and this relationship is mediated by entrepreneurial inspiration, meaning that students who experience meaningful entrepreneurship learning feel more inspired to develop new ideas (Wang et al., 2022). Liang et al. (2025) also argued that practice-oriented entrepreneurship education increases digital entrepreneurial intention by enhancing students' creativity as a mediating mechanism. Gundry et al. (2014) further explained that creativity skills developed in entrepreneurship courses contribute to stronger perceptions of support for innovation and improved team innovation outcomes in the workplace. These findings explain why an experience-rich learning environment, such as PjBL through the Bioentrepreneurship Exhibition, showed a positive correlation with students' entrepreneurial creativity in the present study.

Overall, the correlation coefficient of $\rho = 0.464$, which falls within the moderate category and represents the strongest association among the analyzed variable pairs, indicates that positive perceptions of PjBL through the Bioentrepreneurship Exhibition played a notable role in explaining variation in students' entrepreneurial creativity. Therefore, strengthening the design and implementation of this learning approach deserves attention as a pedagogical intervention. Since the relationship did not reach the very strong category, the development of entrepreneurial creativity should also be supported by additional strategies, such as mentoring programs with entrepreneurs, the strengthening of campus entrepreneurial communities, the integration of competitions and business incubation activities, and the development of an innovation-oriented academic culture. Thus, the findings affirm that Bioentrepreneurship Exhibition-based PjBL

represents a strategic model for fostering entrepreneurial creativity and has a positive and significant association with students' entrepreneurial profiles.

The Relationship between Entrepreneurial Mindset and Entrepreneurial Creativity

The findings showed that the relationship between entrepreneurial mindset and entrepreneurial creativity had a Spearman's rho correlation coefficient of $\rho = 0.358$, with a significance value of 0.001. This correlation was positive and fell within the weak to moderate category. This means that students with a more positive entrepreneurial mindset tended to demonstrate higher entrepreneurial creativity, although mindset was not the only factor influencing creativity. This finding is consistent with the characteristics of both variables, which are shaped by psychological dimensions, learning experiences, and environmental factors. Therefore, it is reasonable that the relationship between the two variables was not very strong, yet remained statistically meaningful. The significant positive correlation also confirms that entrepreneurial mindset serves as a foundation for students' ability to generate creative ideas, identify opportunities from constraints, and develop new approaches to value creation.

The positive relationship between entrepreneurial mindset and entrepreneurial creativity can be explained by the understanding that entrepreneurial mindset includes self-confidence, opportunity orientation, and willingness to take risks, which shape how individuals think and act innovatively. This finding aligns with Cui et al. (2021) who argued that entrepreneurial mindset is influenced by educational effectiveness and inspiring learning experiences, which subsequently strengthen individuals' innovative orientation. Sun et al. (2023) also emphasized that entrepreneurial mindset relates to the ability to think flexibly and proactively in creating new solutions. Therefore, the positive direction of the relationship in this study indicates that students with a stronger entrepreneurial mindset tend to behave more creatively in entrepreneurial contexts.

Overall, the findings showed that all relationships among students' perceptions of PjBL through the Bioentrepreneurship Exhibition, entrepreneurial mindset, and entrepreneurial creativity were positive and significant at the $\alpha = 0.01$ significance level. The strongest relationship was found between students' perceptions of PjBL through the Bioentrepreneurship Exhibition and entrepreneurial creativity, with $\rho = 0.464$. This finding indicates that project-based learning experiences through the Bioentrepreneurship Exhibition represent a highly potential factor in fostering students' entrepreneurial creativity. This result aligns with Artayasa et al. (2024) who found that the biopreneurship Project-Based Learning model improved students' creativity because they engaged in the process of designing biology-based products, testing ideas, revising concepts, and producing creative products with market value.

The relationship between students' perceptions of PjBL through the Bioentrepreneurship Exhibition and entrepreneurial mindset, with $p = 0.402$, was also moderate and significant. This condition indicates that PjBL not only stimulated creativity but also contributed to the formation of a positive entrepreneurial mindset. This finding aligns with Santoso et al. (2023) who showed that Project-Based Entrepreneurial Learning increased motivation, visionary thinking, and risk management skills, which represent core dimensions of students' entrepreneurial mindset. Project-based learning provides students with opportunities to learn through direct experience, problem-solving, teamwork, and self-evaluation, which significantly strengthen entrepreneurial competencies (Wiyono et al., 2025). Therefore, positive perceptions of PjBL through the Bioentrepreneurship Exhibition not only supported students' creativity but also strengthened their entrepreneurial mindset.

Creativity plays an important role in innovation and small business success, but its effect depends on self-confidence and individuals' perceptions of their own capabilities. This condition explains why the relationship between entrepreneurial mindset and entrepreneurial creativity in this study was moderate, as creativity emerges from a combination of cognitive, emotional, and environmental factors, Zampetakis (2008) also showed that entrepreneurial creativity is a multidimensional process influenced by divergent thinking, learning experiences, and academic environmental support. This means that entrepreneurial mindset plays an important role, but it does not act as the dominant factor that fully determines students' creativity.

In general, the findings indicate a mutually reinforcing pattern among the variables. Students' perceptions of PjBL through the Bioentrepreneurship Exhibition had significant direct associations with both entrepreneurial mindset and entrepreneurial creativity. Entrepreneurial mindset served as a psychological variable that linked learning experiences with the ability to generate new ideas. Entrepreneurial creativity emerged as an innovative behavioral outcome triggered by the combination of authentic learning experiences and a healthy entrepreneurial mindset. This relational pattern indicates that the more positively students perceived PjBL through the Bioentrepreneurship Exhibition, the more developed their entrepreneurial mindset and entrepreneurial creativity became.

This study provides empirical evidence that PjBL through the Bioentrepreneurship Exhibition represents an effective pedagogical strategy not only for developing cognitive competencies but also for fostering students' entrepreneurial character. Although the strength of the relationships among variables did not fully reach a high category, the positive and significant direction of the relationships indicates that project-based learning experiences make an important contribution to students' readiness to enter science-based and innovation-oriented entrepreneurship.

CONCLUSION

Students' perceptions of the implementation of Project-Based Learning (PjBL) through the Bioentrepreneurship Exhibition play an important role in shaping the entrepreneurial mindset and entrepreneurial creativity of students in the Biology Education Study Program at UIN Alauddin Makassar. The conclusions of this study are as follows. First, there is a positive and significant relationship between students' perceptions of PjBL and their entrepreneurial mindset, indicating that positive perceptions of PjBL experiences can strengthen students' entrepreneurial thinking. Second, students' perceptions of PjBL are also positively and significantly associated with entrepreneurial creativity, suggesting that exhibition-based PjBL encourages students to be more creative in generating biology-based products and business ideas. Third, there is a positive and significant relationship between entrepreneurial mindset and entrepreneurial creativity, which indicates that a stronger entrepreneurial mindset contributes to the development of students' creativity.

The implications of this study suggest that the implementation of PjBL through the Bioentrepreneurship Exhibition functions not only as an effective instructional strategy but also as a meaningful pedagogical approach for fostering entrepreneurial orientation, innovative thinking, and the ability to create products relevant to the field of biology. Therefore, PjBL can be positioned as an important approach for strengthening students' entrepreneurial soft skills in higher education.

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