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Development of Project-Based Learning Instructional Materials Integrating Bojonegoro's *Jamu Gepyok* Local Wisdom to Enhance Students' Creative Thinking Skills

Iis Sugiati, Nur Kuswanti*, Novita Kartika Indah
Biology Education, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Surabaya, Indonesia.
*Corresponding Author. Email: nurkuswanti@unesa.ac.id

Abstract: This study aims to develop Project-Based Learning (PjBL) instructional materials integrated with the local wisdom of Bojonegoro's *jamu gepyok* that are valid, practical, and effective in improving students' creative thinking skills. The instructional materials consisted of a learning module, student worksheets, and a textbook. The study employed a Research and Development (R&D) approach using the 4D model, which comprises four stages: define, design, develop, and disseminate. The participants were 20 tenth-grade students at SMAN 1 Baureno. The research instruments included validation sheets, pretest and posttest assessment sheets for measuring creative thinking skills, and student response questionnaires. Data were analyzed using descriptive and inferential quantitative methods. The results showed that the instructional materials achieved a mean validity score of 3.97 out of 4.00, indicating a very high level of validity. The materials were also considered highly practical, as reflected in the Fry Graph readability results, which indicated suitability for Grade 10, and the mean student response score of 3.61 out of 4.00. Their effectiveness was demonstrated by an N-Gain score of 0.71, categorized as high, and a paired-samples t-test showing a statistically significant improvement in students' creative thinking skills, $t(19) = -15.32$, $p < .001$. Students also expressed positive responses to the implementation of the instructional materials, with a mean response score of 3.65 out of 4.00. These findings indicate that PjBL instructional materials integrated with the local wisdom of Bojonegoro's *jamu gepyok* can effectively support the development of students' creative thinking skills. The local wisdom of *jamu gepyok* provides an authentic problem context for PjBL by enabling students to investigate local biological resources, identify problems related to the preservation and utilization of traditional knowledge, generate alternative product ideas, design and test solutions, and communicate their products or findings. These activities align with key dimensions of creative thinking, particularly fluency, flexibility, originality, and elaboration.

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Introduction

Human life in the Industry 4.0 era presents challenges commonly referred to as VUCA, an acronym for Volatility, Uncertainty, Complexity, and Ambiguity (Wahyuningsih et al., 2019). Future challenges are characterized by rapidly changing and transient conditions (volatile), uncertainty and unpredictability (uncertain), highly intricate and non-trivial problems (complex), and situations that are unclear, multifaceted, and open to multiple interpretations (ambiguous). Consequently, diverse competencies are required to effectively address these challenges.

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Intelligence-based learning can improve students' abilities by up to 50%, whereas creativity-based learning can enhance them by as much as 200% (Wahyuningsih et al., 2019). Creative thinking skills are crucial for preparing younger generations to navigate a rapidly evolving world by fostering adaptability, innovation, problem-solving abilities, metacognitive awareness, and meaningful understanding of information (OECD, 2024). In contemporary education, creativity is increasingly recognized as a vital competency, as it supports learners' ability to adapt to change, generate ideas, solve problems, and respond innovatively to emerging challenges (Setsoafia et al., 2026; Kraus et al., 2026). It is therefore evident that creative thinking skills are essential competencies that students need to possess.

Every student has the potential to develop creative attitudes, although the level and form of creativity may vary among individuals (Munandar, 1997). Creativity does not emerge merely through the passive reception of information, but develops when individuals actively engage in the thinking process, explore ideas, and seek various possible solutions to a problem. The ability to respond creatively requires the courage to take initiative, try new things, and develop ideas independently. Therefore, creativity can be understood as a dynamic process that involves individuals' active participation in constructing knowledge, experiences, and more innovative ways of thinking.

Based on the PISA 2022 results, the average score among the 64 countries and economies participating in the creative thinking assessment was 33 points, while Indonesia scored 19 points (OECD, 2024). Approximately 60–70% of students who achieved above-average scores in the PISA creative thinking assessment reported that their teachers valued their creativity, encouraged them to produce original responses, and provided opportunities to express their ideas (OECD, 2024). This suggests that classroom pedagogy can significantly influence creative thinking outcomes.

Consistent with these findings, Indonesia's 2025 Education Report, particularly in the aspect of learning quality derived from the results of the National Assessment (Asesmen Nasional Berbasis Komputer/ANBK) conducted by the Ministry of Education, indicates a decline in the quality of learning at the general senior high school level nationwide by 1.14 points (from 63.81 in 2024 to 62.67 in 2025). The learning quality referred to in the Education Report encompasses interactive learning activities that provide more meaningful learning experiences to encourage students to develop the necessary character and competencies.

Teachers, as facilitators of learning, play an important role in designing appropriate instructional models and learning resources that promote students' active engagement. Such engagement encourages students to take greater responsibility for developing their competencies. In the Indonesian education system, creativity is explicitly identified as one of the eight dimensions of the graduate profile for secondary education, as stipulated in Minister of Primary and Secondary Education Regulation No. 10 of 2025 on Graduate Competency Standards (Permendikdasmen No. 10, 2025).

Project-Based Learning (PjBL) is considered an effective instructional approach for cultivating students' creativity through active engagement in project-oriented activities. Its learning process provides opportunities for students to investigate problems, generate ideas, interpret information, and produce tangible outcomes through project completion (Fitri et al., 2024). Previous research has also demonstrated that PjBL can contribute to the development of creative thinking, particularly across the dimensions of fluency, flexibility, originality, and elaboration (Wijayanti et al., 2019). By engaging students in authentic projects and real-world problem situations, PjBL creates meaningful learning experiences that encourage

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students to apply problem-solving strategies while simultaneously strengthening their creative thinking skills (Jaenudin et al., 2020).

Research on the fairness of the PISA 2022 assessment also highlights the importance of considering cultural diversity when assessing creative thinking, as cultural characteristics may influence how students interpret and respond to creative tasks (Cen et al., 2026). Therefore, fostering creative thinking in schools should be supported through contextualized learning experiences that provide students with opportunities to express their ideas and develop solutions to problems that are relevant to their everyday lives. Indonesia possesses rich cultural and linguistic diversity, abundant local wisdom, natural resources, and human resources, which constitute valuable capital for creating more contextual and meaningful learning (Kemendikdasmen, 2025).

Through a Project-Based Learning (PjBL) model integrated with the local wisdom of Bojonegoro, namely jamu gepyok, students are engaged in contextual learning by developing innovative jamu gepyok products to enhance their creative thinking skills. PjBL integrated with local wisdom has been shown to improve conceptual understanding, increase learning motivation, strengthen teamwork, enhance problem-solving abilities, and foster engagement in environmental conservation efforts (Anggarani et al., 2025).

Project-Based Learning (PjBL) has been associated with the development of creativity and creative thinking through authentic learning experiences, problem-solving, collaboration, idea generation, and product creation (Tham, 2024; O'Toole et al., 2026). Research conducted at the secondary school level has also demonstrated that contextualized project-based learning can foster creative thinking alongside other higher-order thinking skills (Lage-Gómez et al., 2026).

In 2023, UNESCO inscribed Indonesia's *jamu* wellness culture on the representative list of the intangible cultural heritage of humanity (UNESCO, 2023). Indonesia is home to various types of jamu, one of which is *jamu gepyok*, a form of local wisdom from Bojonegoro. Knowledge related to *jamu gepyok* is highly relevant to be integrated into school subjects, particularly Biology. The study of *jamu gepyok*, which utilizes diverse plant species as its primary ingredients, aligns with the learning outcomes for phase E (Grade 10 senior high school) in the topic of biodiversity.

Jamu gepyok needs to be innovatively developed while preserving its traditional values to remain relevant to contemporary needs and changing times. Integrating *jamu gepyok* into Project-Based Learning (PjBL) provides students with opportunities to identify problems, explore diverse ideas, design and develop innovative products, and test and communicate their project outcomes. These activities provide authentic learning experiences that encourage students to generate multiple ideas (fluency), explore different approaches (flexibility), produce original ideas (originality), and elaborate on their ideas in greater detail (elaboration). However, the systematic development of instructional materials that integrate PjBL with the local wisdom of *jamu gepyok* to foster students' creative thinking skills in biodiversity education remains limited. Accordingly, this study aims to develop instructional materials based on Project-Based Learning (PjBL) and integrated with the local wisdom of Bojonegoro's *jamu gepyok*, with a focus on ensuring their validity, practicality, and effectiveness in enhancing students' creative thinking skills.

Research Method

This study adopted a Research and Development (R&D) approach based on the 4D development model, consisting of four stages: Define, Design, Develop, and Disseminate (Thiagarajan et al., 1974; Sugiyono, 2019). The define, design, and develop stages were

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conducted at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, while the disseminate stage was conducted on a limited basis through the distribution of the developed instructional materials to Biology teachers through the Biology Subject Teachers' Association (MGMP) in Bojonegoro. The research participants consisted of 20 grade 10 students. The study was conducted from November 2025 to April 2026.

At the define stage, curriculum analysis, learning analysis, and analysis of community knowledge regarding *jamu gepyok* were conducted through interviews. The Design stage involved establishing learning objectives in accordance with the expected learning outcomes, developing the framework of the instructional materials based on Project-Based Learning (PjBL), incorporating Bojonegoro's *jamu gepyok* as a local wisdom context within the learning activities, and preparing appropriate assessment instruments. The subsequent stage, develop, involved producing instructional materials in the form of teaching modules, student worksheets, and textbooks.

The developed instructional materials were subsequently validated by expert lecturers and biology teachers. Following the validation process, the materials were revised to ensure their validity. The validated instructional materials were then implemented with students as part of the disseminate stage. The data collected in this study included validity, practicality, and effectiveness data. Validity data were obtained from two expert lecturers and one Biology teacher using validation sheets covering presentation, content, language, suitability with the Project-Based Learning (PjBL) model, and suitability for fostering creative thinking skills. The validation data were analyzed descriptively by calculating the mean score ($\bar{X} = \Sigma X/N$). Mean scores of 3.26–4.00, 2.51–3.25, 1.76–2.50, and 1.00–1.75 were interpreted as highly valid, valid, less valid, and invalid, respectively.

Practicality data were obtained from the readability level of the developed instructional materials and students' responses after participating in the learning process. The readability level was determined using the Fry Graph, while students' responses were collected using a 4-point Likert-scale questionnaire. The practicality data were analyzed descriptively and interpreted according to the established criteria. Effectiveness data were obtained from students' pretest and posttest scores measuring four dimensions of creative thinking: fluency, flexibility, originality, and elaboration. The effectiveness of the instructional materials was analyzed using the normalized gain (N-Gain) to determine the magnitude of improvement and a paired-samples t-test to determine whether the difference between pretest and posttest scores was statistically significant. Prior to the paired-samples t-test, the normality of the data was examined using the Shapiro–Wilk test. Statistical significance was determined at $\alpha = 0.05$, with $p < 0.05$ indicating a significant difference.

Results and Discussion

The developed instructional materials comprise teaching modules, student worksheets, and textbooks. The activities embedded in these materials engage students in two projects: the development of innovative *jamu gepyok* and the creation of a distribution map of plant species used as raw materials for *jamu gepyok*. These activities are designed to foster students' creative thinking skills.

The teaching module consisted of identity information, learning objectives, and stages of learning activities implemented according to the syntax of the Project-Based Learning (PjBL) model integrated with the local wisdom of Bojonegoro's *jamu gepyok*, as well as learning assessments designed to measure the improvement of students' creative thinking skills through pretests and posttests. The student worksheet contained questions and activities that guided students in carrying out an innovative *jamu gepyok* production project and

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developing a distribution map of the plant species used as raw materials for *jamu gepyok*. Meanwhile, the textbook included general material on biodiversity, *jamu gepyok* as a form of local wisdom, and guidelines for creating biodiversity distribution maps using Google My Maps.

The validation results of the instructional materials conducted by two expert lecturers and one biology teacher obtained an average score of 3.97, which falls into the highly valid category. The detailed validation results of the instructional materials, consisting of the teaching module, student worksheet, and textbook, are presented in Table 1.

Table 1. Detailed Results of the Validation of the Developed Instructional Materials

No	Types of Instructional Materials	Validated Aspects	Average Score	Category
1)	Teaching Module	Presentation feasibility	3.97	Highly valid
		Content feasibility	3.97	Highly valid
		Language feasibility	3.92	Highly valid
		Appropriateness with the PjBL model	3.99	Highly valid
		Appropriateness for fostering creative thinking skills	4.00	Highly valid
	Overall Average Validity Score of the Teaching Module		**3.97**	**Highly valid**
2)	Student Worksheets	Presentation feasibility	3.88	Highly valid
		Content feasibility	4.00	Highly valid
		Language feasibility	4.00	Highly valid
		Appropriateness with the PjBL model	4.00	Highly valid
		Appropriateness for fostering creative thinking skills	4.00	Highly valid
	Overall Average Validity Score of the Student Worksheet		**3.98**	**Highly valid**
3)	Textbook	Presentation feasibility	3.91	Highly valid
		Content feasibility	3.97	Highly valid
		Language feasibility	4.00	Highly valid
	Overall Average Validity Score of the Textbook		**3.96**	**Highly valid**
Overall Average Validity Score of the Instructional Materials			**3,97**	**Highly valid**

The validation findings demonstrated that the developed instructional materials achieved a very high level of validity, confirming their suitability for implementation in the learning process. The learning activities were conducted systematically following the six stages of Project-Based Learning (PjBL): formulating an essential question, planning the project, scheduling activities, monitoring project progress, evaluating the process and outcomes, and reflecting on students' project experiences (Hamidah et al., 2020). The implementation of these activities was guided by the instructional module, which had previously been validated and categorized as highly valid.

The learning process consisted of three meetings with two interrelated topics. The first and second meetings focused on an innovative *jamu gepyok* production project, while the third meeting involved a project on developing a distribution map of the plant species used as raw materials for *jamu gepyok*. The practicality of the developed instructional materials based on the Fry Graph analysis is presented in Figure 1 below.

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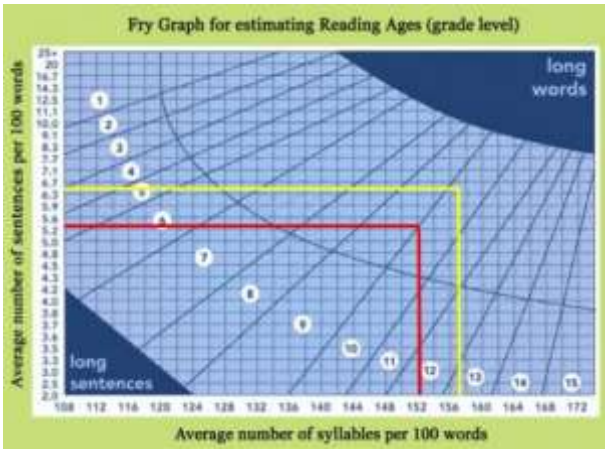

Figure 1. Readability of the Developed Instructional Materials

Based on Figure 1, it can be seen that the readability level of the developed instructional materials falls within Grade Level 10, indicating that the materials are appropriate for tenth-grade students. The red line represents the readability level of the student worksheet, while the yellow line represents the readability level of the textbook. The practicality of the developed instructional materials was also determined based on students' responses. Students' responses to the developed instructional materials, namely the student worksheet and textbook used in the learning process, are presented in Table 2.

Table 2. Detailed Results of Students' Responses to the Developed Instructional Materials

No	Types of Instructional Materials	Practicality Aspects	Average Score	Category
1)	Student Worksheets	Presentation of the Student Worksheet	3,50	Highly Practical
		Materials and Activities in the Student Worksheet	3,57	Highly Practical
		Language Used in the Student Worksheet	3,67	Highly Practical
	Overall Average Practicality Score of the Student Worksheet		**3,58**	**Highly Practical**
2)	Textbook	Presentation of the Textbook	3,62	Highly Practical
		Materials in the Textbook	3,59	Highly Practical
		Language Used in the Textbook	3,72	Highly Practical
	Overall Average Practicality Score of the Textbook		**3,64**	**Highly Practical**
Overall Average Practicality Score of the Instructional Materials			**3,61**	**Highly Practical**

Students engaged in the learning activities with the support of the validated student worksheets as instructional guides. The activities were structured according to the Project-Based Learning (PjBL) stages, providing students with opportunities to actively develop their creative thinking skills throughout the learning process. The creative thinking dimensions emphasized in these activities comprised fluency, flexibility, originality, and elaboration.

The use of PjBL-based instructional materials integrated with the local wisdom of Bojonegoro's *jamu gepyok* was effective in improving students' creative thinking skills. This was indicated by an N-Gain score of 0.71, which was categorized as high, as presented in Table 3. The result was obtained by calculating the improvement in students' learning outcomes based on the pretest and posttest scores. The pretest and posttest instruments used in this study had previously been validated by two expert lecturers. The average pretest and posttest scores of the 20 tenth-grade students of SMAN 1 Baureno who participated as research subjects showed a substantial increase, from 40.63 in the pretest to 82.81 in the

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posttest. The Shapiro–Wilk test indicated that both the pretest and posttest scores satisfied the assumption of normality, with significance values of 0.169 and 0.399, respectively, both exceeding the 0.05 threshold.

Table 3. Results of the N-Gain Calculation Based on Pretest and Posttest Scores

Score	N	Ideal Score	Minimum Score	Maximum Score	Average Score	N-Gain	Category
Pretest	20	100	21,88	65,63	40,63	0,71	High
Posttest	20	100	71,88	93,75	82,81		

The N-Gain score categorized as high, as presented in Table 3, indicates that the implementation of PjBL-based instructional materials integrated with local wisdom was able to provide students with more meaningful learning experiences. Project-based activities emphasize students' active involvement in completing projects, enabling them to gain a deeper understanding of the learning concepts while simultaneously developing their creative thinking skills.

Project-Based Learning (PjBL) can promote the development of creative thinking by engaging students in meaningful project activities that require them to construct ideas, consider multiple approaches to solving problems, and transform their ideas into concrete products. Through sustained involvement in collaborative and contextual learning experiences, students are encouraged to progressively strengthen the four dimensions of creative thinking: fluency, flexibility, originality, and elaboration (Wijayati et al., 2019).

The detailed results of the N-Gain calculation for each indicator of creative thinking skills are presented in Table 4. The N-Gain score for the fluency and flexibility indicators was 0.66, which was categorized as moderate. Meanwhile, the originality indicator obtained an N-Gain score of 0.70, categorized as high, and the elaboration indicator achieved an N-Gain score of 0.80, also categorized as high.

Table 4. Results of the N-Gain Calculation for Each Creative Thinking Indicator

No	Creative Thinking Indicator	Question Number	Result		N-Gain	Average	Category
			Pretest	Posttest			
1)	*Fluency*	1a	1.95	4.55	0.64	0.66	Moderate
		1b	2.05	4.70	0.67		
2)	*Flexibility*	2	2.10	3.35	0.66	0.66	Moderate
3)	*Originality*	3	1.80	3.35	0.70	0.70	High
4)	*Elaboration*	4	1.80	3.81	0.91	0.80	High
		5a	1.75	3.76	0.89		
		5b	1.55	3.00	0.59		

The differences in N-Gain scores across the four dimensions of creative thinking can be explained by the characteristics of the project activities. The moderate gains in fluency and flexibility (0.66) were associated with the limited scope for idea development within the innovative *jamu gepyok* project, as students tended to rely on familiar everyday experiences. Flexibility was primarily developed through activities involving comparisons between liquid and powdered forms of *jamu gepyok* and the selection of the most appropriate form. In contrast, the higher gains in originality (0.70) and elaboration (0.80) were associated with opportunities for students to explore, test, evaluate, and refine innovative products. Students repeatedly modified their ideas when their initial attempts did not produce the expected results and subsequently documented their final products through videos and written reports. Such project-based experiences provide opportunities for idea development, problem-solving, reflection, and creativity (O'Toole et al., 2026; Tham, 2024), while feedback and reflection can support divergent thinking and the evaluation of creative ideas (Schut et al., 2022).

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Activities implemented during project-based learning support the improvement of students' creative thinking skills (Suryandari et al., 2018). In this study, fluency was developed through activities that encouraged students to generate creative ideas to transform *jamu gepyok* into a more contemporary traditional beverage that would appeal to younger generations. These ideas emerged from presenting students with the problem of declining public interest in *jamu gepyok*. The decreasing interest in *jamu gepyok* may eventually lead to the loss of its value as a form of local wisdom. Learning that integrates local wisdom not only preserves local knowledge but also promotes sustainability, improves health, and creates economic opportunities (Nirmala et al., 2024).

Jamu gepyok is generally available in powdered and liquid forms. Comparing these two types of *jamu gepyok* was used as an activity to develop students' flexibility skills. Students examined the strengths and weaknesses of the two types of *jamu gepyok* provided by the teacher. Through in-depth analysis, students determined which type of *jamu gepyok* they considered better and supported their opinions with logical reasons. Project-based activities helped students broaden their perspectives in understanding real-world problems. Students not only sought information from expert opinions but also obtained direct knowledge through project activities. Project-Based Learning assists students in constructing knowledge through the processes they actively experience and perform (Gabuardi, 2021).

Originality, as one of the indicators of creative thinking skills, was developed through activities involving the creation of innovative *jamu gepyok* products while still maintaining the original recipe of *jamu gepyok*. The innovative *jamu gepyok* products created by the students were the result of carefully and systematically planned designs. Students produced various forms of innovative *jamu gepyok*, ranging from contemporary beverages with toppings such as basil seeds and boba to other creative forms. In addition, students transformed liquid *jamu gepyok* into products such as pudding, jelly, candy, cookies, desserts, and milk-based mixtures.

The innovative *jamu gepyok* products that had been created were subsequently documented and reported. The preparation of reports in various media formats according to students' preferences served as an activity to develop the elaboration aspect of creative thinking skills. Through this activity, students learned to develop, expand, and refine ideas into more complex, detailed, and engaging forms. By preparing these reports, students also learned how to communicate the results of their products to others. The reports provided new knowledge regarding the various plant species used as ingredients in *jamu gepyok*, the preparation process, and the health benefits of *jamu gepyok*. In addition to benefiting the students themselves, these reports could also serve as a means of educating the wider community.

Integrating Bojonegoro's *jamu gepyok* local wisdom into Project-Based Learning (PjBL) encouraged students to actively construct knowledge through collaboration, contextual problem-solving, and creative project activities. The instructional module facilitated meaningful learning by connecting students' prior knowledge with authentic experiences. These characteristics align with constructivist principles, which view students as active agents who develop understanding through experience, interaction, and reflection rather than simply receiving information from teachers (Jumaat et al., 2017; Bada & Olusegun, 2015).

A second project involved creating a distribution map of plant species used in *jamu gepyok* production through Google My Maps, providing students with an opportunity to further develop their creative thinking through digital technology. This activity encouraged students to elaborate on their project experiences while engaging actively and collaboratively

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in a technology-supported learning environment. The integration of digital tools can enhance student motivation and learning outcomes by promoting interactive and independent learning (Lin et al., 2017). Moreover, incorporating computer technology into project-based activities can support students in exploring ideas and developing their creativity (Gunawan et al., 2017). The effectiveness of the developed instructional materials was also confirmed through a paired-samples t-test. The results of the t-test conducted on the pretest and posttest scores are presented in Table 5.

Table 5. Results of the Paired-Samples t-Test

t	df	Sig. (2-tailed)
−15.32	19	**< .001**

As shown in Table 5, the paired-samples t-test indicated a statistically significant difference between students' pretest and posttest scores, $t(19) = -15.32$, $p < .001$. This result indicates that students' creative thinking skills significantly improved after the implementation of the developed instructional materials. The findings from the N-Gain analysis, together with the paired-samples *t*-test, demonstrate that the developed instructional materials effectively contributed to the enhancement of students' creative thinking skills, with the improvement being statistically significant. This finding was further reinforced by the positive responses from students, who obtained a mean response score of 3.65 toward the implementation of Project-Based Learning (PjBL) integrated with Bojonegoro's *jamu gepyok* local wisdom, as reported in Table 6.

Table 6. Detailed Results of Students' Responses to the PjBL Model Used in the Learning Process

Indicator	Average Score	Category
Learning Interest and Motivation	3,56	Strongly Agree
Learning Engagement and Activities	3,69	Strongly Agree
Creative Thinking Skills and Attitudes	3,71	Strongly Agree
Appreciation of Local Wisdom	3,65	Strongly Agree
Reflection and Expectations	3,65	Strongly Agree
Overall Average Score	**3,65**	Strongly Agree

The findings in Table 6 demonstrate that students responded favorably to the implementation of Project-Based Learning (PjBL) contextualized through Bojonegoro's *jamu gepyok* local wisdom. The project-oriented learning environment can increase students' engagement by providing opportunities to participate actively, explore ideas, and express creativity while working toward project completion (Ningsih et al., 2020). Incorporating local wisdom into instruction can also contextualize scientific concepts by connecting theoretical knowledge with students' everyday experiences, thereby supporting deeper understanding and longer-term retention (Nurkanti et al., 2026). Nevertheless, the implementation of PjBL may involve practical constraints that require appropriate pedagogical support. Its effectiveness can be strengthened through teachers with adequate instructional competencies, sufficient learning resources and facilities, and consistent educational policies that support sustained implementation (Pratiwi, 2026).

Based on the research findings, including the N-Gain scores, the paired-samples t-test results, and supporting theoretical studies, it can be concluded that the use of Project-Based Learning instructional materials integrated with the local wisdom of Bojonegoro's *jamu gepyok* was effective and significant in improving students' creative thinking skills. These instructional materials can be implemented in contextual, student-centered, and real-world problem-based learning environments, while also supporting character development and equipping students with 21st-century competencies in accordance with the objectives of the Merdeka Curriculum implemented in Indonesia.

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Conclusion

This study developed Project-Based Learning (PjBL) instructional materials integrating Bojonegoro's *jamu gepyok* local wisdom, which were demonstrated to be valid, practical, and effective in enhancing students' creative thinking skills. Integrating *jamu gepyok* into PjBL provided an authentic learning context that connected students' conceptual understanding of biodiversity with the utilization of local plant resources. Through activities involving the exploration of plant materials, generation and development of ideas, design and testing of innovative *jamu gepyok* products, and evaluation and refinement of project outcomes, students engaged in higher-order cognitive processes that supported the development of creative thinking skills. These findings indicate that integrating local wisdom into PjBL can bridge students' conceptual understanding of biodiversity with authentic learning experiences and creative cognitive processes. Overall, this study highlights the potential of locally contextualized PjBL instructional materials to enhance students' creative thinking skills while connecting biological knowledge with the cultural and botanical resources of the local community.

Recommendation

For teachers, the Project-Based Learning instructional materials integrated with the local wisdom of Bojonegoro's *jamu gepyok* can be used as an operational guide in implementing learning activities aligned with learning outcomes and graduate competencies, particularly the creativity dimension of the graduate profile. Meanwhile, future researchers are encouraged to develop instructional materials integrated with other forms of local wisdom to create more contextual learning experiences, as well as to incorporate current technologies to support students in developing 21st-century competencies.

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