Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang. Vol. 13(2) pp 99-109 ISSN:2339-0786
DOI: https://doi.org/10.26714/jps.13.2.2025.99-109

JPS JOURNAL PENDIDIKAN SAINS
JURNAL PENDIDIKAN SAINS
p-ISSN : 2339-0786 o-ISSN : 2502-1443
UNIVERSITAS MUHAMMADIYAH SEMARANG

Development of science modules based on project-based learning integrated STEM to improve students' creative thinking skills

Norma Wati [a,1*], Yudha Irhasyuarna [b,2], Yasmine Khairunnisa [c,3]

[a,b,c] Science Education, Lambung Mangkurat University, 70123, Indonesia

[1]normawatii611@gmail.com
*corresponding author

Article history
Submission : 2025-07-23
Revised : 2025-10-26
Accepted : 2025-11-20

Keyword
Science Module
Project-Based Learning
STEM
Creative Thinking Skills

Abstract

This research was motivated by students' low creative thinking skills and the limited teaching materials used in science lessons. Learning is still teacher-centered, resulting in students' lack of active engagement and lack of opportunities to develop their creativity. Furthermore, the development of science modules based on project-based learning (PBL) integrated with STEM remains limited, and most previous research has focused on cognitive aspects. This situation underscores the need for innovative teaching materials that support active learning and foster students' creative thinking skills. This study aimed to determine the validity, practicality, and effectiveness of a science module based on PjBL integrated with STEM. The research method employed a Research and Development (R&D) approach, utilizing the ADDIE model, which encompasses the stages of analysis, design, development, implementation, and evaluation. The results showed that the developed module met the very valid category with a score of 85.20%. The module was also assessed as practical through small-group trials (76.38%) and large-group trials (80.85%). Furthermore, the module proved effective in enhancing students' creative thinking skills, as evidenced by improved learning outcomes and active engagement. Thus, the STEM-integrated PjBL-based science module is suitable for use in learning.

1. INTRODUCTION

Science teaching in the school environment is not only limited to providing material, but also directed at developing 21st-century skills. The skills in question include thinking creatively and critically, communicating and collaborating, solving problems, and understanding digital literacy. One of the essential skills that students must develop is the ability to think creatively (Ramadhan, 2023).

Creative thinking is the ability to generate original or innovative ideas when faced with problems. However, the reality is that some students still struggle to improve their creative thinking skills. According to the 2021 Global Creativity Index (GCI) survey, Indonesia ranks 87th out of 132

countries, which is considered a strength in terms of creative thinking skills. Of course, the results of this study emphasize the importance of developing learning that encourages creative thinking (Hasanah et al., 2023). Creative thinking skills are crucial for students because they can support them in honing the skills and knowledge necessary for starting a business and creating various innovations.

Creative thinking skills are categorized as low, according to Putri's (2022) research results. Students' less-than-optimal creative thinking skills influence this condition. Thinking creatively is an essential skill because it enables students to devise different and innovative solutions to overcome various challenges. The implementation of education that emphasizes creativity is essential, as it supports students in developing their thinking skills, solving various problems, and fostering interest and motivation to learn. However, based on initial observations, it is evident that students participate less during the teaching and learning process, pay less attention to the teachers, and lack the courage to ask questions or express their opinions. As a result, students tend to be less creative. Lack of creativity in thinking and low student learning abilities are often attributed to the teaching methods employed by teachers. In particular, this problem arises when the method does not directly involve students in their own learning.

Additionally, in learning activities, the delivery of material is conducted using the lecture method. Teachers still apply traditional learning methods, which affects the level of student creativity and has an impact on student behavior that tends to be passive during the learning process, ultimately affecting their low learning creativity. Therefore, it is crucial to foster the development of creative thinking so that students can understand the material more deeply and achieve maximum learning outcomes.

One approach to enhancing students' creative thinking is to utilize the appropriate learning model. The project-based learning approach is one alternative that can be used in the teaching and learning process (Munawwaroh & Munahefi, 2024). According to Fahmi and Wuryandini's (2020) findings, the project-based learning model has been shown to have a positive impact on the development of students' creative thinking skills. Project-focused learning methods have proven successful in improving creative thinking skills. Through its application, students are involved in real projects that require them to create innovations and solve problems. The project-based learning model provides students with the opportunity to explore and understand concepts through real-world experiences. According to Brigili, as quoted in Ravitz (2021), learning using the project model encourages students to be directly involved in solving problems with an innovative approach that comes from experience. This experience is expected to be a source of learning that develops students' creative thinking skills during the learning process. (Lestari & Ilhami, 2022).

Project-focused learning is considered one of the most effective methods for helping students develop these skills, as it enables students to interact directly with the subject matter through projects connected to real-life experiences (Irawan et al., 2023). Lantang et al. (2023) found that learning methods that incorporate projects can support students in developing creativity, critical thinking, problem-solving skills, and collaboration with others. The project-based learning model has a greater influence when integrated with the use of technology over time. One of them is by combining the science, technology, engineering, and mathematics (STEM) approach. STEM is a method that unites four main components in education: science, technology, engineering, and mathematics, enabling students to develop skills in innovation, design, and creativity (Dewi et al., 2023).

Based on the results of observations at SMP Negeri 15 Banjarmasin, it is known that the available learning resources are still minimal, consisting only of LKS books, textbooks, and learning that tends to be more focused on the teacher (teacher-centered). The limited availability of inadequate teaching materials causes teachers to rely more often on conventional methods, such as direct explanations or drawings on the blackboard, which results in students being less focused and having difficulty concentrating during learning. These results align with the study by Rozali et al. (2022), which suggests that teachers often rely on guidebooks from educational institutions, frequently employ oral teaching methods, and require students to write their answers on the blackboard. As a result, students become passive during learning activities because their role is limited to paying attention to the teacher's explanation. In addition, teaching materials that are not varied and less interesting often cause boredom and decreased student enthusiasm.

Therefore, it is necessary to develop more engaging teaching materials and encourage active student participation so that learning is more effective, enjoyable, and helps build their creative thinking skills. This can be achieved by developing learning materials in the form of project-based modules that are integrated with STEM. Integrated project-based STEM modules can support students in understanding learning materials in depth and enhancing their creative problem-solving abilities in real-life scenarios (Izzania, 2021). Research by Agung et al. (2021) supports this finding, revealing that the application of STEM-PjBL helps students strengthen their analytical, creative, and critical thinking skills. Hanif et al. (2019) also revealed that the STEM-PjBL model is a learning approach that is considered reliable, valid, relevant, and effective in enhancing creativity.

However, to date, the development of teaching materials in the form of science modules that specifically integrate the PjBL model with the STEM approach on the topic of simple machines remains very limited, particularly in its aim to enhance the creativity of junior high school students. In addition, the focus of development is usually on cognitive learning outcomes, not on the ability to think creatively. Based on this explanation, it is necessary to develop a science module that integrates STEM principles into PjBL. This module is expected to help students develop creative thinking strategies when learning science.

2. METHOD

The type of research applied in this study is research and development (R&D). The product developed is a science module that incorporates a project-based learning approach with STEM. The development model used in this study is ADDIE (Rosidi et al., 2023). The ADDIE model provides opportunities for evaluation and improvement at each stage of the process, so that the final product is considered valid and reliable (Didelmi et al., 2023). This model includes the stages of analysis, design, development, implementation, and evaluation. The steps of the ADDIE model are illustrated in the following figure.

Figure 1. ADDIE model.

The subjects in this study were two science education lecturers and one science subject teacher, serving as validators, and students of class VIII F at SMP Negeri 15 Banjarmasin, who served as trial participants. The data collected included validity data through expert validation sheets, practicality data through student response questionnaires, and effectiveness data through pre-test and post-test assessments in the form of multiple-choice questions, arranged based on creative thinking indicators, including fluency, flexibility, originality, and elaboration. The instruments used were validation sheets, student response questionnaires, and creative thinking tests. Data analysis was conducted using percentages to assess the level of validity and practicality, as well as the Wilcoxon test and N-Gain calculation to evaluate the effectiveness of the module in enhancing students' creative thinking abilities. The following formula and validity assessment criteria are used.

$$P = \frac{f}{n}\ x\ 100\% \text{.....(1)}$$

Description: P: Percentage of questionnaire data
F: total assessment score
N: total maximum assessment score

Table 1. Validity criteria

Interval	Criteria
81≤ P < 100%	Very Valid
61≤ P <81%	Valid
41≤ P <61%	Moderately Valid
21≤ P <41%	Invalid
0≤ P <21%	Very Invalid

Practicality analysis is obtained from student response questionnaires. The following formulas and criteria are used to determine the level of practicality.

$$P = \frac{f}{n}\ x\ 100\% \text{.....(2)}$$

Description: P: Percentage of questionnaire data
F: number of assessment scores
N: the maximum number of assessment scores

Table 2. Module Practicality Criteria

Interval	Criteria
81≤ P < 100%	Very Practical
61≤ P <81%	Practical
41≤ P <61%	Moderately Practical
21≤ P <41%	Not Practical
0≤ P <21%	Very Not Practical

(Ate et al, 2022)

The test instrument was applied in the effectiveness analysis to assess the level of students' creative thinking before and after using the module. Students' pre-test and post-test scores will be tested for normality before the n-gain data is used. According to Kadir (2020), the normality test aims to check whether the data obtained is usually distributed. If the results of the normality test indicate a normal distribution, then the N-gain calculation is performed to assess the increase in students' creative thinking abilities. The formula and assessment criteria are as follows.

$$\text{N-Gain} = \frac{posttest\ value - pretest\ value}{ideal\ value - pretest\ value} \quad \text{.....(3)}$$

Description: Post-test score: Initial score
Pre-test value: Final score
Ideal score: maximum score

Table 3. N-gain Value Criteria

No	Interval	Criteria
1	g < 0,3	Low
2	0,3 ≤ g <0,7	Medium
3	g ≥ 0,7	High

(Nita et al, 2022)

3. RESULTS AND DISCUSSION

The result of this development is a product, namely a science module that uses project-based learning (PjBL) integrated with the STEM approach on the topic of simple machines. The development of this module aims to enhance students' creative thinking skills during learning activities. This research was conducted at SMP Negeri 15 Banjarmasin to assess the validity, practicality, and effectiveness of the STEM-integrated PjBL-based science module

Analysis

The initial stage of this development involves identifying problems in science learning and the needs of students. There are three types of analysis carried out, namely.

a. Needs analysis

The needs analysis stage begins through observations of teaching assistance activities at SMP Negeri 15 Banjarmasin. From the results of observations, it is evident that teachers in science learning tend to employ the lecture method, rely on LKS books and textbooks, and adopt a teacher-centered approach. This makes students less actively involved and tends to render them passive, as their role is limited to listening to the explanation provided.

Based on the analysis data collected at the research location, the school does not yet have a PjBL-STEM-based science module. In the learning process at SMP Negeri 15 Banjarmasin, teachers deliver materials using various media, including printed books, and provide assignments and practice questions directly taken from the book. The results of interviews with science teachers revealed that students' levels of creative thinking are relatively low. Therefore, a more innovative and effective learning approach is needed to improve these abilities. Based on the analysis results, the researcher proposes an alternative solution to address the low level of student activity and the limited

availability of teaching materials, namely the development of a science module based on project-based learning integrated with the STEM approach.

b. Material Analysis

This stage involves analyzing the material that will be used as content in the development of the science module. The material is selected based on the primary material and learning experience related to the topic to be delivered. Before developing the learning module, the researcher and the science teacher discussed the material that would be used in the module. The material used by the researcher in the science module, based on STEM-integrated PjBL, is simple machine material. This topic is considered relevant because of its close relationship with daily activities.

c. Analysis of Learning Objectives

With the existence of learning objectives, researchers can understand and analyze the components that can be included in the science module. Learning objectives help teachers determine and organize teaching materials, carry out more focused learning activities, and make it easier for them to conduct assessments. The curriculum analysis used by schools as a reference for learning is the independent curriculum. According to Pitasari and Febriyanti (2023), learning objectives are more effective when formulated using the ABCD formula. This formula is used to specify the sound and learning objectives to be compiled. The term ABCD is an abbreviation that includes A (Audience), B (Behavior), C (Condition), and D (Degree).

Design

The next stage is the design stage. This stage marks the beginning of product design, specifically the science module, which is developed using a project-based learning approach and STEM integration. This module is intended for grade VIII students. However, this design is still temporary, as it will undergo further development based on input and comments from the validator in the future. This stage integrates all analysis findings into product development, ensuring the resulting module is of high quality and ready for use in the learning process. The module creation process is carried out using the Canva application.

Development

The development stage is a phase in which a complete product is created that has been designed in the previous phase. Determination of validity is carried out based on a questionnaire assessed by two Science Education lecturers and a Science teacher at SMPN 15 Banjarmasin. The results of the validation questionnaire assessment of the Science module, as evaluated by the validators, are presented in the following table.

Table 4. Science module validity results

Assessment Aspects	Validator			Percentage	Criteria
	I	II	III		
Content Eligibility	55	65	68	89.52%	Very Valid
Presentation	66	73	79	80.74%	Valid
Language	40	40	48	85.33%	Very Valid
Overall Average				**85.20%**	**Very Valid**

Referring to Table 4, which is presented, it shows that the module achieved an overall percentage of 85.20%. According to Ate et al. (2022), the percentage of 85.20% falls within the "Very valid" category. However, the module still needs to be revised based on feedback and input from the validators. The input and responses of the validators are presented in Table 5 below.

Table 5. Comments and suggestions by validators

Validator	Comments and suggestions
1	No comment
2	(1) Learning objectives using the ABCD format (Audience, Behavior, Condition, Degree) (2) Make the concept map more interesting (3) Provide a column to answer questions (4) Create a visualization from the picture next to the definition/understanding of simple planes. (5) Questions adjust to the learning objectives
3	No comment

The research findings indicate that the science module, designed using the PjBL approach and STEM integration, is feasible for students in terms of material, presentation, and language use. The results of the study by Nita et al. (2020) support this statement, which suggests that modules considered valid or very valid by expert validators have met the criteria for feasibility of use.

Implementation

Following the assessment of the science module, based on project-based learning, which was deemed very good according to the results of expert validation, the next step was to conduct a product trial in schools. This test was conducted at SMP Negeri 15 Banjarmasin for grade 8 students. This test aims to assess the practicality of the science module that has been prepared.

Practicality of Science Module

The practicality of the science module was assessed through a student response questionnaire containing 20 statements, both positive and negative. There were 16 positive questions and four negative questions. After the validation and revision process of the science module was completed, the next stage was to conduct a trial of learning in limited groups. The trial implementation on a small scale was carried out by involving ten students as research subjects. Table 6 below presents the results of the practicality test for the science module conducted in a small group of ten students.

Table 6. Small group testing results

No	Assessment Aspects	Overall Score	Criteria
1	Ease of use of the module	77.50%	Practical
2	Attractiveness of the module	80.83%	Practical
3	Presentation	70.94%	Practical
4	Benefits	76.25%	Practical
Average		**76.38%**	**Practical**

The results of the questionnaire completed by students during a small-scale trial showed an average value of 76.38%, which falls within the practical category. Following the trial, which involved ten students, the module revision was conducted based on the input and responses provided by the students. After making improvements, a field trial was conducted involving twenty-five students from Class VIII F of SMP Negeri 15 Banjarmasin to assess the practicality of the module. The results of the practicality test for the science module, with a total of twenty-five students as respondents, are presented in Table 7 below.

Table 7. Large group trial results

No	Assessment Aspects	Overall Score	Criteria
1	Ease of use of the module	80.67%	Practical
2	Attractiveness of the module	80.67%	Practical
3	Presentation	80.75%	Practical
4	Benefits	81.33%	Very Practical
Average		**80.85%**	**Praktis**

Based on the results of the large-scale testing questionnaire, an average score of 80.85% was achieved, which falls within the practical category. This indicates that the science module, based on STEM integrated project-based learning, is practical for students to apply in the learning process, as seen from the perspectives of ease of use, module appeal, presentation method, and benefits.

Effectiveness of Science Module

The effectiveness of the science module is evident from the results of the N-gain score calculation, which compares the students' pre-test and post-test scores. The initial test and final test were conducted on twenty-five students to measure the effectiveness of the developed module. The learning outcome assessment used included ten multiple-choice questions, and the scores obtained were processed using the N-gain formula. The data obtained are displayed in tabular form.

Table 8. Module effectiveness results

Value Data	Number of students	Average score
Pre-test	25	30,80
post-test	25	78,40

The researcher conducted a normality test on the students' pre-test and post-test data to determine whether the data met the assumption of normal distribution. To determine the data distribution, the researcher conducted a normality test analysis using the SPSS application, and the results are presented below.

.Table 9. Data Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.238	25	.001	.841	25	.001
Postest	.196	25	.015	.863	25	.003

a. Lilliefors Significance Correction

The results of the normality test indicate that neither follows a typical distribution pattern. Kadir (2020) stated that data is considered normal when the significance value exceeds 0.05. Conversely, if the significance value is ≤ 0.05, then the data is considered not to have a normal distribution. The results obtained show that this data is not normal because both significance values are ≤ 0.05. Additionally, a homogeneity test was conducted to verify the homogeneous nature of the data. Data is considered homogeneous if the significance value is greater than or equal to 0.05. The table below shows the results of the homogeneity test.

Table 10. Results of data homogeneity testing

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Nilai	Based on Mean	2.747	1	48	.104
	Based on Median	2.495	1	48	.121
	Based on Median and with adjusted df	2.495	1	34.290	.123
	Based on the trimmed mean	2.457	1	48	.124

Table 10 shows that the p-value is greater than or equal to 0.05, indicating that the data obtained have the same variance or are homogeneous. Given that the previous normality test did not meet the normality requirements, a non-parametric test was conducted next, namely the Wilcoxon Signed-Rank Test. This test was conducted to observe and compare the differences between the students' pre-test and post-test results. Information on the findings is shown in the illustration below.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between Pretest and Postest equals 0.	Related-Samples Wilcoxon Signed Rank Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Figure 2. Wilcoxon test results

`Referring to the picture mentioned, it shows a significant difference between the pre-test and post-test results. This result shows a significant increase following the implementation of the intervention. The implementation of the science module, utilizing PjBL and integrating STEM, is successful in enhancing students' creative thinking skills.

The following diagram shows significant differences in the mean pre-test and post-test scores in terms of creative thinking indicators.

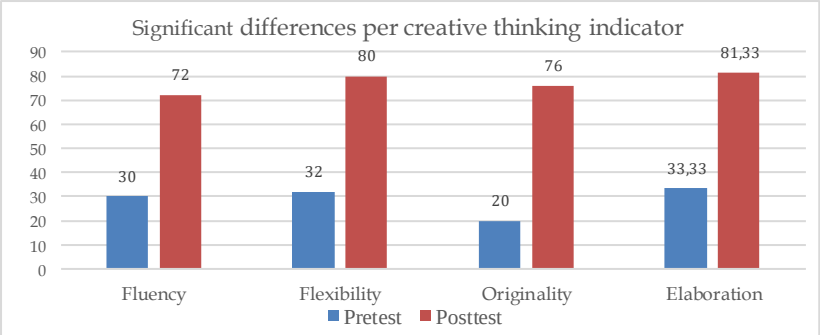

Figure 3. Significant differences in values per creative thinking indicator

The results above indicate that the level of students' creative thinking on each indicator in the pre-test showed the lowest value on the originality indicator, at 20.00%, and the highest value on the elaboration indicator, at 33.33%. In the post-test, the highest value was achieved on the elaboration indicator with a percentage of 81.33%. In comparison, the lowest value was obtained by the fluency indicator with a value of 72.00%. Thus, the results of the study indicate that the science module can be used effectively as teaching materials in learning activities to develop students' creativity.

The first indicator of creative thinking is the fluency indicator, which measures a student's ability to express their ideas fluently and generate diverse thoughts related to a problem. The results of the initial analysis of creative thinking skills showed that the average pre-test score was 30.00, while the average post-test score reached 72.00. This happens because, during the learning process using the PjBL-STEM approach, students are expected to explore ideas related to the problems listed in the module, which include pictures. Students are then asked to find or convey answers and solutions that are appropriate to the problem. The increase in the score indicates that students can improve their answers, express ideas fluently, and convey them quickly and appropriately. This finding aligns with Meldawati et al. (2022), who note that the fluency stage involves integrating previously acquired knowledge to answer questions. This aligns with the characteristics of PjBL, which requires students to continually propose ideas and explore various solutions throughout the learning process. This finding is supported by other studies, such as those conducted by Rahmawati et al. (2022), which showed that students who applied the STEM approach demonstrated a significant increase in creative thinking skills because they were accustomed to brainstorming and experimenting when solving problems.

The second indicator of creative thinking is the flexibility indicator, which measures students' ability to generate diverse ideas, answers, or questions. Findings in this aspect indicate that students can identify various alternative solutions to problems, although they still struggle to find the most effective solution. The results of Febrianti et al.'s (2016) study align with these findings, which suggest that this ability enables students to develop new concepts, solutions, or questions and view problems from multiple perspectives.

The third indicator of creative thinking is the originality indicator, which measures a student's ability to think about problems or aspects that others have not considered and to generate different and innovative ideas. In this study, the aspect of novelty (originality) occupies the second-lowest position, with a pre-test score of 20.00 and a post-test score of 76.00. This study aligns with Wahyuni and Palupi's (2022) research, which suggests that the element of novelty is the lowest factor in creative thinking ability. The results in this aspect are evident when students struggle to find innovative solutions to problems.

Elaboration is the fourth indicator of creative thinking, which involves students' ability to generate new ideas and expand or explain the details of specific objects, concepts, or situations to make them more interesting. The results of the analysis on this indicator show an increase in creative thinking skills, as indicated by a rise in the pre-test score from 33.33 to 81.33 on the post-test. These results indicate that students have been able to produce or provide solutions in their own language. This can be observed in the learning process, where students discuss compiling report results, creating products or projects, and then present their findings. Qomariyah and Subekti (2021) stated that elaborative thinking is seen when students can create solutions that are conveyed in their own

words, offer comprehensive, detailed, and structured solutions, and formulate appropriate ideas and solutions based on available information.

The implementation of a project-focused learning model in the learning process affects students' creative thinking. This statement aligns with the views of Larasati and Aslamiah (2023), who stated that teachers need to emphasize the practice of abilities in the teaching process so that learning outcomes are not solely centered on cognitive abilities. The findings of Meldawati et al. (2022) support this statement, as they indicate that implementing a project-focused learning model is effective in enhancing creative thinking skills.

Evaluation

Each phase in the ADDIE development model, from analysis to design, development, and implementation, is thoroughly evaluated and assessed. Evaluation is used to evaluate the quality of the product produced. At the analysis stage, researchers seek information related to problems in learning and the need for teaching materials to find the right solution. As an effort to solve the problem, researchers developed a science module that combines the PjBL model, which aims to facilitate junior high school students in developing their creative thinking skills. At the design stage, researchers evaluated the module by enhancing its aesthetic appeal, thereby improving the overall beauty of the module. During the implementation stage, the module was revised in accordance with the suggestions and recommendations of the validator to ensure that its quality was improved and worthy of dissemination. The evaluation stage involves completing research at each stage of development.

4. CONCLUSION

Based on the results of research and development carried out, the science module, integrated with project-based learning and the STEM approach, is deemed suitable for improving the creative thinking skills of junior high school students. The conclusions of this study can be formulated as follows: (1) The science module based on project-based learning integrated with STEM obtained a validity value of 85.20%, which is included in the very valid category, (2) The module also has a high level of practicality, with a practicality score of 80.85%, according to the results of the student response questionnaire, (3) The science module that combines project-based learning and the STEM approach has proven effective in developing the creative thinking skills of junior high school students.

ACKNOWLEDGMENTS

The author wishes to convey heartfelt thanks to the supervising lecturer, expert validator, teachers, school, and everyone involved who assisted and facilitated the successful execution of this research.

REFERENCES

Agung, I. D. G., Suardana, I. N., & Rapi, N. K. (2021). Science E-Module with STEM-PjBL Model Oriented to Character Education to Improve Student Learning Outcomes. Scientific Journal of Education and Learning. 6(1), 120-133

Ate, O., Sundaygara, C., & Pranata, K. B. (2022). Development of PjBL-Based Textbooks with a STEM Approach to Improve Students' Conceptual Understanding of Fluid Material for Grade XI High School. RAINSTEK: Journal of Applied Science & Technology. 4(4), 246–255.

Dewi, N. N. S. K., Arnyana, I. B. P., & Margunayas, I. G. (2023). Project Based Learning Berbasis STEM: Meningkatkan Kemamuan Berpikir Kritis dan Hasil Belajar Siswa. Jurnal Ilmiah Pendidikan Profesi Guru, 6(1), 133-143. https://dio.org/10.23887/jippg.v6i1.59857

Didelmi, A., Yennita, & Zulfarina. (2023). Development of PjBL-STEM-Based E-module Using Professional 3D Pageflip Application on Optics Material to Improve Critical Thinking Skills and Learning Interest of Junior High School Students. National Seminar on Educational Sciences.

Fahmi & Wuryandini (2020). Analysis of creative thinking skills in project-based learning of electrolyte solutions in high school students. Journal of Chemistry Education Innovation. 14(2), 2608–2618.

Febrianti, Y., Djahir, Y., & Fatimah, S. (2016). Analysis of Students' Creative Thinking Skills by Utilizing the Environment in Economics Subjects at SMA Negeri 6 Palembang. Journal Profit, 3(1), 121–127.

Hadinugrahaningsih, T. (2017). 21st Century Skills and STEAM (Science, Technology, Engineering, Art, And Mathematics) Project in Chemistry Learning. Jakarta: Jakarta State University

Hanif, S. Wijaya, A. F. C., & Winarno, N. (2019). Enhancing Students' Creativity through STEM Project-Based Learning. Journal of Science Learning, 2(2), 50–57.

Hasanah, M., Supeno, S., & Wahyuni, D. (2023). Development of Professional Flip PDF-based E-Modules to Improve Learners' Creative Thinking Skills in Science Learning. Tarbiyah Wa Ta'lim: Journal of Education and Learning Research, 10(1), 44-58. https://doi.org/10.21093/twt.v10i1.5424

Irawan, M. F., Zulhijrah, & Prastowo, A. (2023). Natural Science Learning Planning Based on Project-Based Learning in the Independent Curriculum in Elementary Schools. PIONIR Journal of Education. 12 (3), 38–46. Https://Dx.Doi.Org/10.22373/Pjp.V12i3.20716

Kadir. (2020). Applied Statistics Third Edition. Depok: Rajawali Pers.

Lantang, E. R., Sumilat, M. J., & Tarusu, D. T. (2022). Development of Integrated Project-Based Learning (IPBL) Learning Devices in STEM to Improve Students' Science Creativity. Scientific Journal of Wahana Pendidikan. 9 (16), 803–808. https://doi.org/10.5281/zenodo.10139662

Larasati, N., & Aslamiah. (2023). Improving Students' Creative Thinking Skills in Science Content Using the BARITO Learning Model in Class V of SDN 3 Landasan Ulin Barat. Journal of Social Education and Counseling, 1 (3), 956–965.

Lestari, I., & Ilhami, A. (2022). Implementation of the Project-Based Learning Model to Improve Junior High School Students' Creative Thinking Skills: Systematic Review. Lensa (Lentera Sains): Journal of Science Education. 2(12), 135–144.

Meldawati, Hamid, A., & Mahdian. (2022). Implementation of Project-Based Learning (PjBL) MODEL Assisted by Chemondroid Module Application on Creative Thinking Ability in Compound Nomenclature Material. JCAE (Journal of Chemistry And Education). 2(6), 54-63.

Munawwaroh, A. M., Sugiman, & Munahefi, D. N. (2024). Students' creative thinking skills in the project-based learning model based on STEM (science, technology, engineering, and mathematics). PRISMA, national mathematics seminar proceedings. 7, 987–991.

Nita, R., Syubhan, A., & Sari, M. M. (2020). Development of a science module on the material of the movement system in living things based on local wisdom. Indonesian Journal of Natural Science Education (IJNSE). 3(1), 281–292. https://doi.org/10.31002/nse.v3i1.877

Pitasari, M. A. R., & Febriyanti, B. D. (2022). Analysis of Completeness in Formulating Learning Objectives for PGMI Semester V Students. Qalam, 1(12), 35-42.

Putri, A. E. (2022). Development of Learner Worksheets (LKPD) Based on PJBL-STEM (science, technology, engineering, and mathematics) to Train Learners' Creative Thinking Skills (Doctoral dissertation, UIN Sunan Ampel Surabaya).

Qomariyah, D. N., & Subekti, H. (2021). Analysis of Creative Thinking Ability: An Exploratory Study of Students at SMPN 62 Surabaya. Pensa E-Journal: Science Education, 9(2), 242-246.

Rahmawati, L., Juandi, D., & Nurlaelah, E. (2022). Implementation of STEM in Improving Critical and Creative Mathematical Thinking Ability. AKSIOMA: Journal of Mathematics Education Study Program.3(11), 2002-2014. https://doi.org/10.24127/ajpm.v11i3.5490

Ramadhan, W. (2023). STEAM Approach-Based Learning through Project-Based Learning (PjBL) to Improve Elementary School Students' Science Literacy. Ibriez Journal: Journal of Islamic Elementary Education Based on Science, 8(2), 171-186

Ravitz, J. (2021). Pervasive management of project-based learning teachers as guides and facilitators. Handbook of Classroom Management. 593–626. https://doi.org/10.4324/978020387-31

Rosidi, A., Rohman, F., Novianti, & Hariadi, I. (2023). Development of PBL-based E-module of Diversity of Living Things with Local Wisdom and its Effect on Critical Thinking Skills, Problem Solving, and Environmental Attitudes. Bioscientist: Scientific Journal of Biology, 2(11), 1662-1677.

Rozali, A., Irianto, D. M., & Yuniarti, Y. (2022). Study of Problematic Teacher-Centered Learning in a Student Learning Case Study: SDN Dukuh, Sukabumi. Journal of Elementary Education, 5(1), 78–80.

Wahyuni, D., & Palupi, B. S. (2022). Analysis of Mathematical Creative Thinking Ability of Grade V Elementary School Students Through Open-Ended Questions. Jurnal Kiprah Pendidikan, 1(2), 76-83.