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The Ethno-STEM Project Based Learning Model in Fostering Prospective Teachers' Creativity in Designing Science Learning Media and Modules for Primary Schools

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Abstract: Creativity is a crucial ability in teacher education, especially for prospective teachers, as it relates to designing innovative, engaging, and contextually relevant learning strategies, methods, and media. However, the creativity of prospective teachers in designing primary science learning remains a challenge, as teaching practices are often conventional and less connected to local cultural contexts. This study aims to examine the effectiveness of the Ethno-STEM Project Based Learning (PjBL) model in fostering prospective teachers' creativity in designing science learning media and modules for primary schools. The research was conducted at a University in Mataram involving 59 students of the Elementary School Teacher Education study program, divided into two classes. Data were collected using product assessment observation sheets with a Likert-scale questionnaire (1–4), and the scores were analyzed descriptively to determine the level of creativity demonstrated in the students' products. The results show that students successfully developed learning products in the form of media and modules integrated with Ethno-STEM. Based on 15 indicators, the average score for learning media was 81.69, while the average score for modules was 82.52. These findings indicate that the products were in the good category, reflecting a positive impact of the model on fostering prospective teachers' creativity.

Keywords: Ethno-STEM, Project Based Learning, Prospective Teacher, Creativity, Science Learning.

INTRODUCTION

Science learning at the elementary school level plays a strategic role in building students' foundational understanding of natural phenomena and developing critical thinking skills. However, science learning at this level is often still dominated by conventional approaches that tend to be theoretical, less contextual, and less engaging for students (Nurmalasari et al., 2024). This condition leads to low learning motivation and limited student engagement in the learning process. For prospective teachers, the ability to design science learning that is engaging, relevant, and contextual presents its own challenge. They are required to demonstrate creativity in designing science instruction. Creativity, as defined by Guilford (1967a), includes divergent thinking, flexibility, originality, and elaboration, which are essential skills for 21st-century educators. Creativity not only supports the success of science learning but also provides students with meaningful learning experiences (Naimah, 2022).

Ethno-STEM, an approach that integrates science, technology, engineering, and mathematics (STEM) with local wisdom, offers an innovative solution for designing science learning (Primadianningsih et al., 2023). Ethno-STEM can enhance the relevance of learning to students' environments, strengthen their engagement in the learning process, and support the development of critical thinking skills (Hiqmah et al., 2023) as well as creativity (Izzah & Wardani, 2023). This approach becomes even more effective when combined with the Project Based Learning (PjBL) model, which emphasizes real-world project-based learning. PjBL enables learners to develop collaboration, problem-solving, and creativity skills through the exploration of authentic problems and the development of tangible products (Arsinah & Kadir, 2024). In the context of teacher education, the combination of Ethno-STEM and PjBL can be used to train students to design lesson

modules and learning media that are engaging, rooted in local wisdom, and aligned with STEM elements. For example, prospective teachers may design simple experiments using traditional technologies, explain scientific principles through local community practices, or develop teaching aids from locally available materials.

Although the Ethno-STEM approach integrated with PjBL has great potential to foster creativity, its implementation in higher education, particularly in elementary science learning courses, remains very limited. Few studies have measured the effectiveness of this model in developing prospective teachers' creativity. In fact, creativity is a core competence that prospective teachers must possess to support innovative teaching that is relevant to local cultural contexts. This study aims to examine the effectiveness of the Ethno-STEM Project Based Learning (PjBL) model in enhancing prospective teachers' creativity. The research employed a quasi-experimental method with a pretest-posttest control group design. The Ethno-STEM PjBL model was implemented through several main stages, namely identifying problems based on local culture, planning STEM-based projects, developing innovative products, testing and evaluating, and reflecting on the learning outcomes.

METHODS

This research employed a quasi-experimental method. The study was conducted at a University in Mataram and involved 59 students enrolled in the Elementary School Teacher Education study program. The participants were divided into two classes: one class served as the experimental group, which received instruction using the Ethno-STEM Project Based Learning (PjBL) model, while the other class served as the control group, which received conventional instruction. The Ethno-STEM PjBL model was implemented through five main stages: (1) identifying problems based on local cultural contexts, (2) planning projects by integrating STEM elements, (3) developing innovative learning products, (4) testing and evaluating the products, and (5) reflecting on the learning process and outcomes.

Data were collected using product assessment observation sheets. The instrument consisted of 15 indicators measuring creativity in developing learning media and modules, and was assessed using a Likert scale ranging from 1 (poor) to 4 (excellent). The data were analyzed descriptively and comparatively to determine the effectiveness of the Ethno-STEM PjBL model in fostering prospective teachers' creativity

FINDINGS AND DISCUSSION

Science learning in elementary schools requires prospective teachers not only to master scientific concepts accurately but also to develop creative thinking skills and produce contextual learning media. Creativity is an essential competency for prospective teachers as it is directly related to their ability to design innovative and relevant strategies, media, and teaching materials that meet students' needs. Therefore, this study evaluated the effectiveness of the Ethno-STEM Project Based Learning (PjBL) model on prospective teachers' creativity, assessed not only through tests but also through the learning products developed by students in the form of elementary science media and modules.

Product assessment was carried out using a Likert-scale rubric (1–4) consisting of 15 evaluation aspects, ranging from the accuracy of scientific concepts and the integration of local culture to creativity indicators such as fluency, flexibility, originality, and elaboration. The evaluation of the media and module products yielded average scores as presented in Figure 1.

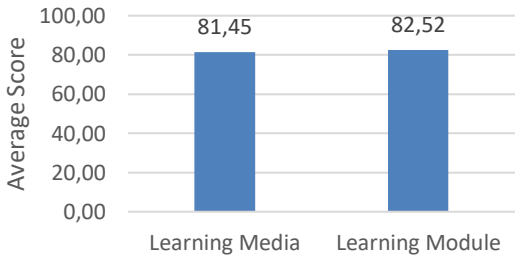

Figure 1. Scores of Student-Created Science Learning Media and Modules

The assessment of learning media and module products in this study was conducted using a Likert-scale questionnaire consisting of 15 items. The analysis results showed that the average score for the learning media was 81.45, while the learning modules obtained an average score of 82.52. Both scores fall into the good category, indicating that students were able to produce learning products that met most of the evaluation indicators with high quality.

For the learning media, the score of 81.45 reflects that students were fairly successful in producing innovative and engaging products aligned with the Ethno-STEM principles. The media were rated as meeting aspects such as alignment of content with learning objectives, integration of local wisdom, clarity of presentation, and visual appeal. However, this score was slightly lower compared to the modules, suggesting that aspects related to design, aesthetics, and ease of use of the media still need improvement to maximize their support for the learning process. Meanwhile, the learning module score of 82.52 indicates a higher quality. The modules were assessed as presenting well-structured content, clear project-based learning steps, and relevant evaluation instruments. The advantage of the modules compared to the media lies in their ability to provide a more systematic guide for both teachers and students, thereby facilitating the implementation of learning. Moreover, the modules successfully integrated local wisdom within the STEM framework, making them more contextual and meaningful.

From the perspective of the Likert-scale assessment, the high scores across both products demonstrate consistent positive performance on most indicators. This reinforces the finding that the implementation of the Ethno-STEM Project Based Learning model is effective in encouraging students to produce creative, applicable, and relevant learning products for elementary science education. According to Hanif (2019), students engaged in project-based learning with a STEM approach on light and optics material exhibited good creativity, particularly in the dimensions of resolution (problem-solving ability), elaboration (idea development), and novelty (originality of ideas). These findings indicate that project-based learning with a STEM approach stimulates students not only to understand scientific concepts theoretically but also to apply them in real-world contexts through challenging project activities. Furthermore, such learning steps cultivate students' creative dispositions, including imagination in project design, increased curiosity, risk-taking, adaptability to the environment, greater independence, as well as patience and perseverance (Musa & Kamal, 2024).

Therefore, both the media and modules produced are not only feasible for use in learning practice but also serve as examples of innovative products that integrate local culture with modern science. These findings emphasize the importance of adopting project-based learning models to develop prospective teachers' creativity in designing instructional materials. The analysis was also carried out based on the scores of each assessment item. The evaluation items for the media products included: (1) Accuracy of elementary science concepts; (2) Alignment with learning objectives and competencies; (3) Integration of the Ethno-STEM approach in media content; (4) Representation of local cultural elements; (5) Use of local contexts in exploring STEM concepts; (6) Visual design (color, typography, layout); (7) Navigation and interactivity of media use; (8) Potential to enhance students' motivation, creativity, and critical thinking; (9) Alignment of media with elementary school teaching strategies; (10) Relevance of media to students' real-life contexts; (11) Fluency – the number of ideas/functions presented in the media; (12) Flexibility – the variety of uses or different approaches within the media; (13) Originality – uniqueness of visual ideas, interactions, or content; (14) Elaboration – depth and richness of media features/content; and (15) Team collaboration in media development. The scores for each assessment item of the learning media are presented in Figure 2**.**

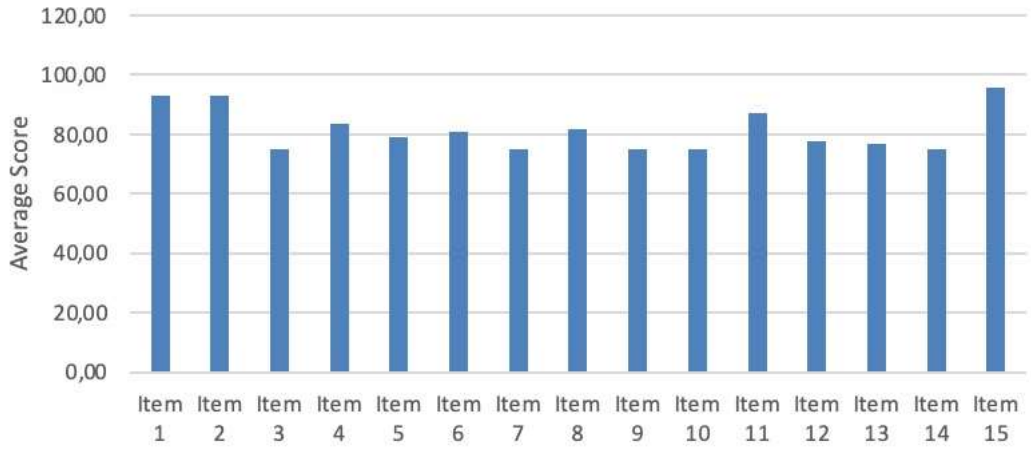

Figure 2. Average Scores of Learning Media Product Assessment by Indicator

The assessment results of student-produced learning media based on 15 indicators using a Likert scale revealed a wide variation of scores. Overall, the media developed by the students achieved an average score within the "good" category, with the highest ratings found in team collaboration (95.76), accuracy of elementary science concepts (92.80), and alignment with learning objectives and curriculum standards (92.80). These results indicate that students were able to present scientific concepts accurately, in accordance with the curriculum, while also demonstrating strong teamwork skills in developing quality products. In terms of cultural representation, the media obtained a score of 83.47, suggesting that local cultural elements were fairly well integrated into the learning content. Similarly, the use of local contexts in exploring STEM concepts scored 79.24, showing that such contexts were utilized, although not to their fullest potential. A comparable pattern was seen in the media's visual design, which scored 80.93, indicating that the appearance was fairly appealing but could still be improved in terms of color, typography, and layout to enhance communicative effectiveness.

Furthermore, the score of 81.78 for the potential to foster student motivation, creativity, and critical thinking implies that the media was able to encourage learner engagement, though further refinements could optimize its impact. On the other hand, some indicators were rated lower, including integration of the Ethno-STEM approach (75.00), navigation and interactivity (75.00), coherence with elementary school learning strategies (75.00), and relevance to students' real-life contexts (75.00). These findings highlight that while local culture was integrated into the media, a deeper fusion of STEM elements with cultural wisdom, as well as improved interactivity, remain key challenges.

From the perspective of creativity, fluency or the ability to generate a variety of ideas—received a relatively high score of 87.29, showing that students were able to include multiple functions and features in their products. However, flexibility (77.54), originality (76.69), and elaboration (75.00) were comparatively lower. This suggests that while students were able to generate sufficient ideas, the variety of applications, uniqueness, and depth of content still require further development. In general, the student-produced learning media can be categorized as "good," as they were able to meet most of the evaluation indicators. The strongest aspects were found in conceptual accuracy, curriculum alignment, and team collaboration. Nonetheless, the main weaknesses lay in the insufficient integration of Ethno-STEM principles, limited interactivity, and lack of content depth and originality. These findings suggest that the Ethno-STEM Project Based Learning model is fairly effective in producing quality instructional products, but further improvement is needed to enhance innovation and contextualization in media development to better support elementary science learning.

In addition to learning media, the student-produced learning modules were also analyzed using 15 assessment items covering key aspects. These items included: (1) accuracy of elementary science concepts; (2) alignment with learning objectives and curriculum standards; (3) integration of the Ethno-STEM approach into module structure; (4) representation of local cultural elements; (5) integration of local cultural contexts in

exploring STEM concepts; (6) coherence of instructional model syntax in learning activities; (7) systematic structure in accordance with teaching module guidelines; (8) potential to foster creativity and critical thinking; (9) relevance of activities to students' real-life contexts; (10) presentation of media/tools within learning activities; (11) fluency—variety of activities and ideas; (12) flexibility—range of approaches or activities; (13) originality—uniqueness of strategies or approaches; (14) elaboration, depth of content, task variety, and reflection; and (15) team collaboration in module development. The average scores for each item are presented in Figure 3.

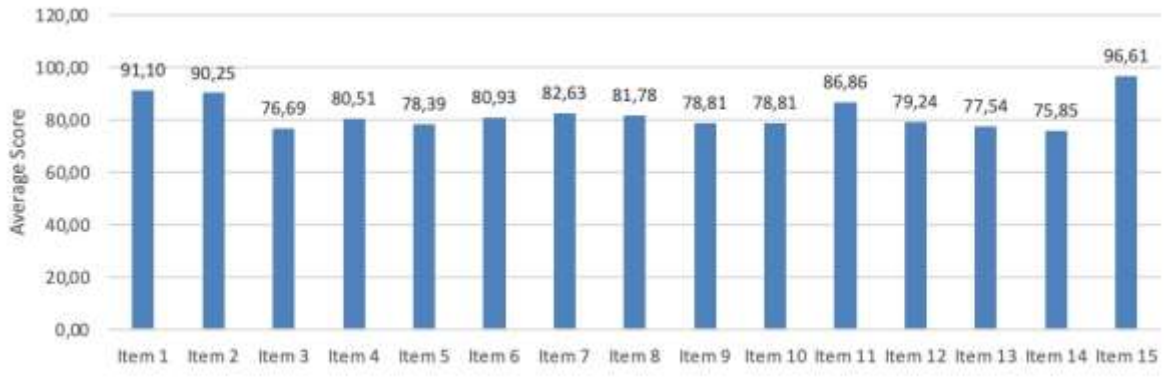

Figure 3. Average Scores of Learning Module Product Assessment by Indicator

The assessment results of the student-produced learning modules indicate that, overall, the quality of the products falls into the "good" category, with an average score of 82.52. In terms of substance, the modules achieved high scores in the accuracy of elementary science concepts (91.10) and alignment with learning objectives and learning outcomes (90.25). This confirms that the modules presented content in accordance with the curriculum and provided accurate understanding for learners. Furthermore, the modules demonstrated representation of local culture (80.51) and integration of local cultural contexts in STEM exploration (78.39), indicating that cultural wisdom was incorporated into the learning content, though further improvement remains possible. From a presentation perspective, the modules were considered systematic (82.63) and consistent with the syntax of the learning model (80.93), which makes them accessible for both teachers and students. The potential of the modules to enhance creativity and critical thinking (81.78), as well as the relevance of activities to real-life contexts (78.81), was also acknowledged, although these scores were slightly lower than those in the substantive aspects. This suggests the need to further strengthen the connection between learning activities and students' everyday experiences to ensure greater contextual relevance.

The creativity dimension of the modules was reflected in several indicators. Fluency (86.86) showed that the modules offered a wide range of alternative activities. Meanwhile, flexibility (79.24) and originality (77.54) indicated some variation and uniqueness, though they could be further developed to make the learning ideas fresher and more innovative. On elaboration (75.85), the modules scored relatively lower, suggesting the need for deeper content exploration, greater task variety, and richer reflection. Nevertheless, the high score in team collaboration (96.61) demonstrates that the students worked together effectively in developing comprehensive modules. This approach combines elements of local wisdom and STEM within a project-based learning method, making it a unique solution for creating contextual and meaningful science learning. Ethno-STEM offers the advantage of linking scientific concepts with local cultural values (Martawijaya et al., 2023). A local culture–based approach can enhance the relevance of learning and actively engage students (Islami et al., 2024). Moreover, ethnoscience aims to connect modern scientific knowledge with the local wisdom that has long been practiced by communities (Ismail et al., 2024). This study presents a comprehensive integration of ethnoscience and STEM, making it highly relevant for project-based learning.

The implemented PjBL model is recognized as a promising approach to

improving higher education learning (Guo et al., 2020) and has also been proven effective in enhancing student creativity through exploration and development of authentic projects (Chen et al., 2022). PjBL allows learners to actively engage in the learning process actively, sharpening critical thinking, collaboration, and problem-solving skills (Ramadhan & Hindun, 2023). This study reinforces these advantages by designing projects that explicitly integrate local cultural elements into STEM-based teaching modules and learning media. From the creativity perspective, the study also stands out by focusing on creativity dimensions such as fluency, flexibility, originality, and elaboration, which Guilford, (1967b) identify as key indicators for measuring individual creativity.

The implementation of the Ethno-STEM Project-Based Learning model in this study demonstrates strong potential for cultivating the creative and cultural responsiveness of prospective elementary school teachers. However, several challenges emerged during the process. Students required substantial guidance in translating local cultural elements into meaningful STEM learning components, indicating that deeper scaffolding and iterative feedback cycles are essential for optimizing the design phase. In addition, limited experience with digital media development and constraints in technological facilities affected the level of interactivity and visual sophistication in the learning products. The successful adoption of STEM-based project-based learning relies heavily on structured mentoring, adequate resources, and focused training to enhance educators' pedagogical and technological competencies. Research indicates that effective professional development (PD) for teachers is essential, with particular emphasis on the necessity for ongoing support throughout the implementation phase of project-based learning (PBL) (Rogers et al., 2010). Altan et al. argue that established mentoring protocols provide teachers with immediate assistance and foster an environment in which educators can acquire advanced instructional techniques tailored to STEM education (Altan et al., 2025). This mentorship not only helps teachers integrate technology into their pedagogical practices but also ensures they possess the requisite skills to use modern ICT tools effectively (Dawadi, 2022).

Moreover, time management and workload balance posed notable barriers, as project-based instruction demands extended planning, collaboration, and field exploration of cultural contexts. Some student teams tended to focus on finishing tasks rather than refining aspects of creativity, such as elaboration, originality, and contextual depth, suggesting the need for clearer rubrics, milestone checkpoints, and reflective evaluation sessions. Future implementation of Ethno-STEM PjBL should therefore emphasize sustained mentoring, collaborative design studios, and culturally immersive activities to deepen students' understanding of how local wisdom can enrich STEM learning. Strengthening institutional support and integrating cross-disciplinary expertise, particularly from cultural studies and educational technology, would further enhance the quality and authenticity of student-produced learning modules.

Overall, these findings reveal that the modules developed by students through the Ethno-STEM Project-Based Learning model successfully integrated local wisdom, STEM approaches, and aspects of creativity. While certain dimensions such as elaboration, originality, and real-life relevance still require enhancement, the modules generally met the expected quality standards and support innovative, contextualized science learning in elementary schools.

CONCLUSION

This study concludes that the Ethno-STEM Project Based Learning (PjBL) model is effective in fostering the creativity of prospective elementary school teachers in designing science learning products. Students produced media and modules of good quality, particularly in content accuracy, curriculum alignment, and team collaboration, demonstrating the model's ability to integrate local cultural values with STEM principles while fostering creative competencies such as fluency, flexibility, originality, and elaboration. However, aspects such as media interactivity, module elaboration, and contextual relevance still require improvement. Therefore, it is suggested that teacher education programs implement Ethno-STEM PjBL systematically, providing continuous guidance to strengthen the integration of local wisdom with STEM concepts and to stimulate richer creative elaboration in student projects. Further research is recommended to examine the long-term effects of this model on prospective

teachers' professional competencies and its applicability across diverse cultural contexts and science topics, ultimately supporting the preparation of innovative, contextual, and culturally responsive science educators.

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REFERENCES

Altan, E. B., Coşkun, T. K., Öztürk, N., & Hacıoğlu, Y. (2025). Science teachers' mentoring support experiences when integrating technology in design-based learning STEM activities. PLoS One, 20(9), e0332047.

Arsinah, A., & Kadir, M. (2024). Implementasi Arsinah, A., & Kadir, M. (2024). Implementasi Project Based Learning (PJBL) dalam menumbuhkan kreativitas pada pembelajaran ilmu pengetahuan alam dan sosial (IPAS). *Jurnal Tarbiyah dan Ilmu Keguruan Borneo, 5*(3), 161–173.

BChen, S. Y., Lai, C. F., Lai, Y. H., & Su, Y. S. (2022). Effect of project-based learning on development of students' creative thinking. *The International Journal of Electrical Engineering & Education, 59*(3), 232–250.

Dawadi, M. P. (2022). Community College Teachers' Perceptions and Practices of ICT Integrated Teaching. Journal of Bhuwanishankar, 1(1), 1-22.

Guilford, J. P. (1967a). Creativity: Yesterday, today and tomorrow. *The Journal of Creative Behavior, 1*(1), 3–14.

Guilford, J. P. (1967b). *The nature of human intelligence*. New York, NY: Macgraw Hill.

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research, 102*, 101586. https://doi.org/10.1016/j.ijer.2020.101586

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.

Hiqmah, N., Rienovita, E., Al-Latief, I. S., Sholehuddin, S., & Santosa, T. A. (2023). Effectiveness of ethno-STEM based chemistry to improve students critical thinking skills. *Jurnal Penelitian Pendidikan IPA, 9*(SpecialIssue), 72–79.

Islami, J. M. M., Ilmin, L., Afny, D. N., Supriyanto, A., & Habibi, M. M. (2024). SLR: Penerapan pembelajaran berbasis komunitas untuk meningkatkan kompetensi peserta didik di era disrupsi. *Jurnal Ilmiah Profesi Pendidikan, 9*(4), 2832–2848.

Ismail, I. A., Weriza, J., Mawardi, M., Lufri, L., Usmeldi, U., Festiyed, F., & Handri, S. (2024). Tinjauan sistematis analisis integrasi etnosains dalam pembelajaran IPA dan dampaknya terhadap kompetensi era modern dan nilai-nilai Pancasila. *Jurnal Pendidikan dan Teknologi Indonesia, 4*(5), 207–219.

Izzah, S. N., & Wardani, S. (2023). Analysis of science concept mastery, creative thinking skills, and environmental attitudes after ethno-STEM learning implementation. *International Journal of Instruction, 16*(3).

Martawijaya, M. A., Rahmadhanningsih, S., Swandi, A., Hasyim, M., & Sujiono, E. H. (2023). The effect of applying the Ethno-STEM-project-based learning model on students' higher-order thinking skill and misconception of physics topics related to Lake Tempe, Indonesia. *Jurnal Pendidikan IPA Indonesia, 12*(1), 1–13.

Musa, M. M., & Kamal, R. (2024). Project-based learning model for strengthening elementary students' creativity in sciences. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, 29–42.

Naimah, K. (2022). Inovasi pembelajaran IPA SD dengan pemanfaatan media KIT alat sederhana yang berasal dari lingkungan sekitar untuk meningkatkan kompetensi dan kreativitas

siswa. *Formosa Journal of Science and Technology, 1*(2), 97–110.

Nurmalasari, N., Radiah, R., Rahmawati, R., & Darmaniar, D. (2024). Penerapan pembelajaran kontekstual berbasis demonstrasi dalam meningkatkan hasil belajar IPA dan kemampuan literasi sains siswa. *Cokroaminoto Journal of Primary Education, 7*(2), 495–505.

Primadianningsih, C., Sumarni, W., & Sudarmin, S. (2023). Systematic literature review: Analysis of ethno-STEM and student's chemistry literacy profile in 21st century. *Jurnal Penelitian Pendidikan IPA, 9*(2), 650–659.

Ramadhan, E. H., & Hindun, H. (2023). Penerapan model pembelajaran berbasis proyek untuk membantu siswa berpikir kreatif. *Protasis: Jurnal Bahasa, Sastra, Budaya, dan Pengajarannya, 2*(2), 43–54.

Rogers, M. A. P., Cross, D. I., Gresalfi, M. S., Trauth-Nare, A. E., & Buck, G. A. (2011). First Year Implementation Of A Project-Based Learning Approach: The Need For Addressing Teachers'orientations In The Era Of Reform. International Journal of Science and Mathematics Education, 9(4), 893-917.