BIOPENDIX: Jurnal Biologi, Pendidikan dan Terapan
Volume 13, Issue 1, March 2026
Pages: 21-26
https://doi.org/10.30598/biopendixvol13issue1page21-26

P-ISSN:2407-4969
E-ISSN:2684-8341

Original Article

OPEN ACCESS

Analysis of Science Learning Implementation in the Implementation of the Independent Curriculum at the Junior High School Level

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Submitted: October 30, 2025; Accepted: October 12, 2025; Available online: November 27, 2025, Published: March 31, 2026

Abstract. This study aims to analyze the implementation of science education in the Merdeka Curriculum at the junior high school level. The research method used is descriptive qualitative, with data collected through observation, interviews, and documentation. This study examines the learning tools, learning resources and media, and strategies applied by teachers in learning activities. The results of the study show that the implementation of science learning in the Merdeka Curriculum still encounters various obstacles, such as learning that tends to be teacher-centered, lack of utilization of laboratories and technology-based media, and teaching tools that are not fully in line with the principles of differentiation and project-based learning. Nevertheless, teachers try to adapt to the curriculum requirements by using Merdeka Curriculum textbooks and conducting simple discussions in class. This study concludes that the implementation of the Merdeka Curriculum in science learning requires support in the form of improving teacher skills, providing technology-based learning media, and developing innovative and contextual teaching tools. In this way, science learning can be more dynamic, meaningful, and in line with the characteristics of learning in the 21st century.

Keywords: Learning Media; Merdeka Curriculum; Qualitative Descriptive; Science learning; 21st Century Skills.

How to cite this article:
Situmeang, J. C., Nababan, N., & Simanjuntak, M. (2026). Analysis of Science Learning Implementation in the Implementation of the Independent Curriculum at the Junior High School Level. *BIOPENDIX: Jurnal Biologi, Pendidikan dan Terapan*, *13*(1), 21-26. https://doi.org/10.30598/biopendixvol13issue1page21-26

Journal homepage: https://ojs3.unpatti.ac.id/index.php/biopendix
Journal e-mail: jbiopendix@gmail.com

INTRODUCTION

Science education plays an important role in shaping students' critical, logical, and creative thinking skills. Through science learning, students are not only required to understand scientific concepts, but also to be able to apply them in real life through observation, experimentation, and problem solving. According to Parisu et al. (2024), effective science learning must be student-centered, where students play an active role in discovering concepts through a structured scientific process. However, the implementation of science learning in schools still faces a number of challenges.

In addition to teaching tools, limitations in media and learning resources also pose significant obstacles. Rahmani et al. (2025) found that most science teachers still rarely utilize digital technology-based media due to limitations in facilities and technical capabilities. However, the results of research by Wibisari & Mulyani (2024) show that the use of interactive media such as e-books and educational videos can significantly improve students' conceptual understanding and motivation to learn. Another obstacle that arises is the suboptimal implementation of innovative learning models and methods. According to Sari et al. (2024), the Project-Based Learning (PjBL) model has been proven effective in improving students' critical and creative thinking skills, but its implementation is still rare due to time constraints and teacher readiness. Similarly, research by Sipahutar (2022) shows that problem-based learning can encourage students to think scientifically and collaboratively, but it requires comprehensive support in terms of equipment and authentic assessment.

The low implementation of learning oriented towards the development of 21st century skills, such as critical thinking, creativity, communication, and collaboration (4C), shows a gap between education policy and learning practices in the field. Therefore, an in-depth analysis and reflection on science learning practices is needed in order to make them more active, contextual, and supportive of the development of students' scientific competencies and character in line with the demands of the 21st century.

MATERIALS AND METHODS

This study uses a descriptive qualitative approach that aims to describe in depth the actual conditions of science learning in the context of the implementation of the Merdeka Curriculum. This approach was chosen because it is suitable for examining natural and complex educational phenomena without manipulating the research variables. Through this approach, researchers can understand various aspects that occur in the field, ranging from planning, implementation, to evaluation of learning conducted by teachers. The subjects in this study consisted of one science teacher and a group of seventh-grade students at a private junior high school in Medan. The subjects were selected using purposive sampling, considering that the teacher studied had implemented the Merdeka Curriculum and was actively teaching science. The research location was chosen at a school that had begun implementing the curriculum so that the data obtained would be relevant to the focus of the research. The main instrument in this study was the researcher himself, assisted by several data collection tools, including: Observation Sheets, used to record learning activities, the use of media and learning resources, and the learning strategies applied by teachers. Interview Guidelines, compiled to obtain in-depth information about teachers' understanding of the Merdeka Curriculum, the obstacles they face, and the innovations they have implemented in science education. Documentation, in the form of collected documents such as teaching modules, textbooks, student assessment results, and photos of learning activities as supporting evidence.

The data collection process was carried out in three main stages, namely: Observation, to obtain a direct picture of the implementation of learning in the classroom, including interactions between teachers and students, as well as the use of learning facilities. In-depth interviews were conducted with science teachers to explore their views, strategies, and obstacles in implementing the curriculum. Documentation was used to supplement the data from observations and interviews with written and visual evidence. During the data collection process, researchers maintained objectivity by systematically recording all findings in the field (Daruhadi & Sopiati, 2024).

Data analysis was conducted using Miles and Huberman's interactive analysis model, which consists of three stages: Data Reduction, which is the process of simplifying and sorting data according to the research focus. Data Presentation, which is organizing data into narratives or tables to facilitate interpretation. Drawing Conclusions and Verification, which is the process of finding meaning and patterns from the data presented to produce valid research findings. To ensure the validity of the findings, this study used source and method triangulation techniques, which is comparing the results of observations, interviews, and documentation to obtain consistency of information. In addition, member checks were conducted with informants to ensure that the researcher's interpretations were consistent with the actual conditions (Creswell & Poth, 2016).

RESULTS AND DISCUSSION

Overview of Science Learning Implementation

Based on observations, science teaching at the junior high school level still shows a tendency toward traditional learning patterns. The learning process is dominated by lectures, in which teachers are the center of information while students play a passive role. Government textbooks are used as the main reference, and experiments are only conducted occasionally due to time constraints and limited laboratory facilities. As a result, two-way interaction and active student participation in learning have not developed optimally. This condition illustrates that the principle of student-centered learning, which is at the core of the Merdeka Curriculum, has not been fully implemented. Many science teachers still use conventional methods due to a lack of training in developing teaching tools and implementing innovative learning models. In fact, the Merdeka Curriculum emphasizes student-oriented learning through contextual, collaborative, and creative activities. In addition, the low frequency of practical activities is one of the main obstacles in achieving science learning objectives. Laboratory activities are an important component that can help students understand scientific concepts concretely, practice scientific process skills, and foster a scientific attitude. The lack of experimental activities makes it difficult for students to relate theory to empirical experience.

Implementation of the Independent Curriculum in Science Education

The interview results show that teachers have made efforts to follow the Merdeka Curriculum structure in scheduling and textbook use. However, teaching practices are still limited to conventional material delivery. Project-based learning and problem-based learning models have not been implemented consistently. Teachers also have not yet incorporated Pancasila Student Profile Strengthening Projects (P5) into the science learning process. These findings are in line with Heryahya et al. (2023) opinion, which states that the successful implementation of the Merdeka Curriculum is highly dependent on teachers' readiness to understand the new learning philosophy and paradigm. Without a change in perspective and teaching strategies, the implementation of the curriculum will only be administrative in nature. Therefore, improving teacher capacity through training, mentoring, and reflection on teaching practices is a strategic step to ensure that the Merdeka Curriculum is implemented substantially.

Science Learning Tools

The documentation results show that teachers do not yet have complete learning tools such as teaching modules, student worksheets, and authentic assessment instruments. The learning process is still oriented towards textbooks as the only source of learning. In fact, teaching tools are an important component that can support successful learning and facilitate more meaningful learning activities. Mukarromah & Adriana (2022) explains that learning tools should be systematically arranged based on the competencies to be achieved and provide space for teachers' creativity in designing active learning activities. The incompleteness of teaching tools means that teachers lack guidance in designing learning that fosters higher-order thinking skills (HOTS). Use of inquiry-based LKPD has been proven to improve students' critical thinking skills because it encourages them to discover concepts through exploratory activities. In addition, the forms of assessment used by teachers are still focused on cognitive aspects, while the affective and psychomotor domains have not been comprehensively evaluated.

Use of Media and Learning Technology

The results of the observation show that the learning media used are still limited to conventional tools such as pictures or diagrams. The use of information technology in learning is minimal. Teachers have not utilized digital media such as interactive videos, scientific simulations, or online learning platforms that can enrich students' learning experiences. Learning media play an important role in helping students understand abstract concepts and improving the effectiveness of teacher communication. The results of research by Rais et al. (2024) also show that the controlled use of smartphones and simple digital media can increase learning motivation and understanding of scientific concepts. Therefore, teachers need to utilize easily accessible technology—such as YouTube learning videos, the PhET Simulation application, or the Google Classroom platform—to make learning activities more interesting and meaningful.

Learning Approaches, Models, and Methods

Observational data shows that the approach used by teachers is still traditional, with lectures as the main strategy. Learning activities that involve exploration, experimentation, or scientific projects are still rarely carried out. This results in students lacking active and collaborative learning experiences. In fact, the Merdeka

Curriculum encourages the application of various innovative learning models such as Inquiry-Based Learning, Project-Based Learning (PjBL), Problem-Based Learning (PBL), and Discovery Learning. The PjBL model can improve critical thinking and problem-solving skills because it involves students in the process of designing and completing real projects. Therefore, teachers need to innovate in their choice of learning models so that learning activities are more contextual and foster scientific curiosity.

Integration of 21st Century Skills in Science Education

The application of 21st-century skills, which include Critical Thinking, Creativity, Communication, and Collaboration (4C), is still not optimal in science learning at Harapan Baru Private Junior High School in Medan. The learning process observed is still teacher-centered, with a predominance of lecture and exercise methods, so that students do not have enough space to think critically, innovate, and collaborate actively. Research by Anugrah et al. (2024) shows that the application of the Problem-Based Learning (PBL) model, which requires collaboration and scientific communication, can significantly improve the critical thinking and science literacy of junior high school students. Similarly, Sari et al. (2024) found that the integration of Project-Based Learning (PjBL) in science learning encourages students' creativity and learning responsibility because they are directly involved in solving real problems. In the context of critical and creative thinking, the limitations of experimental activities and scientific projects mean that students are not accustomed to analyzing natural phenomena in depth. Kastur et al. (2025) stated that PjBL has been proven to be able to integrate the four indicators of creative thinking, namely fluency, flexibility, novelty, and elaboration simultaneously in each stage. Meanwhile, communication and collaboration aspects have also not developed due to the lack of discussion and group presentation activities. Scientific communication activities, such as presenting observation results, can strengthen students' conceptual understanding and confidence. This condition shows that the integration of 4C in science learning is still potential but has not been implemented systematically. Teachers need to adopt active and project-based learning strategies that provide opportunities for students to collaborate, communicate ideas, and solve contextual problems. In line with the findings of Monika et al. (2022), the success of developing 4C in science learning depends on the ability of teachers to facilitate student exploration and innovation through interactive and contextual approaches.

General Discussion

Overall, the results of the study show that the implementation of science learning in the Merdeka Curriculum has shown progress in structural aspects, but substantively still faces a number of obstacles. The main problems include limited teaching tools, minimal use of ICT-based media, lack of variety in learning methods, and low implementation of authentic assessment. Nevertheless, the enthusiasm and discipline of teachers in teaching are positive potentials that can be further developed. Solutions that can be applied include the development of inquiry- and project-based teaching tools, teacher training to improve technological literacy, and the strengthening of authentic evaluation systems. Melati et al. (2023) state that the use of technology in learning can significantly increase student engagement and motivation. By implementing more active, contextual, and technology-based learning, it is hoped that the science learning process at the junior high school level can become more effective, meaningful, and in line with the spirit of the Merdeka Curriculum, which encourages student independence and creativity.

CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that the implementation of science learning in the Merdeka Curriculum at the junior high school level has not been fully optimized. In general, learning activities are still teacher-centered, while student activity and independence in the learning process are still limited. The use of learning media and technology has not been maximized, and experiments and scientific projects are still rarely conducted. In addition, teaching tools such as modules and student worksheets do not fully accommodate inquiry-based or project-based learning. Learning assessment is still focused on cognitive aspects and does not yet measure affective abilities and scientific process skills authentically. This shows that the main principles of the Merdeka Curriculum—namely, differentiated, contextual, and student-centered learning—have not been fully realized.

To improve the quality of science education, several strategic steps can be taken, including: Developing teaching tools that support inquiry-based and project-based learning, Encouraging teachers to utilize digital media and technology as a means of active learning, Integrating 21st century skills (4C) into teaching and learning activities, and Optimizing authentic assessment to measure students' competencies comprehensively.

By implementing these steps, science education is expected to become more innovative, participatory, and capable of fostering scientific character in students in line with the spirit of the Merdeka Curriculum.

The researchers would like to express their deepest gratitude to the lecturer of the Science Program Development course for providing guidance and direction throughout this research process. We would also like to thank the school for providing opportunities and support in conducting observations and interviews. Last but not least, we would like to thank our fellow students who helped in the data collection process and the preparation of the final research report. It is hoped that the results of this research can contribute to improving the quality of science education at the junior high school level and serve as a reference for teachers and other education researchers.

ACKNOWLEDGEMENTS

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript

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