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AN EVALUATION OF SCIENTIFIC LITERACY IN JUNIOR HIGH SCHOOL SCIENCE LEARNING UNDER THE MERDEKA CURRICULUM

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ABSTRACT

Using the CIPP (Context, Input, Process, and Product) assessment paradigm, this research seeks to examine students' scientific literacy in junior high school science learning as it pertains to the Merdeka Curriculum. Participating in the study were 105 students and science instructors from several Semarang junior high schools, using a mixed-method sequential explanatory design. We used the One-Sample Wilcoxon Signed-Rank exam with a benchmark score of 84 to evaluate quantitative data acquired from a scientific literacy exam, and we used the four CIPP stages to descriptively assess qualitative data received from teacher surveys. Students' scientific literacy scores were found to be significantly lower than the specified standard ($p<0.05$) according to the product assessment findings.with an average achievement of 36–40%, categorized as nominal scientific literacy. The context phase shows that teachers generally perceive the curriculum as relevant to students' needs, although differences in school readiness remain. The input phase reveals that facilities and training have been provided, yet practical and sustained professional support is still limited. The process phase indicates that inquiry-based and project-based strategies have been implemented but not consistently due to time constraints and variations in teacher readiness. Overall, although the Merdeka Curriculum aligns conceptually with the goals of scientific literacy development, its current implementation has not yet produced optimal literacy outcomes, highlighting the need for strengthened contextual, inquiry-based, and project-based learning practices.

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1. INTRODUCTION

The development of modern technology and the acceleration of digital transformation have significantly changed various fields, one of which is the education sector in Indonesia. The dynamics of scientific development, particularly in the field of science, require students to not only keep up with the flow of information, along with the ability to think critically and adjust to new situations. Today's challenges can be addressed by the existence of competent human resources as a strategic necessity for the advancement of the national education system. To that end, the ability to comprehend and implement scientific ideas in one's daily life, as well as to analyze and interpret data,are key competencies that every student must possess (Irsan, 2021). From the outset, scientific literacy has been viewed as an important goal in science education because of its role that goes beyond simply understanding basic concepts. In addition, scientific literacy contributes to preparing individuals who are able to make responsible decisions and support the achievement of sustainable development (Mansfield & Reiss, 2020). From 2000 to 2022, scientific literacy in Indonesia remained relatively low. With a score of 383, Indonesia fell 13 places from the 2018 results and landed 71st out of 81 nations in scientific literacy, according to the 2022 Programme for International Student Assessment (PISA) report. According to Fauziah et al. (2024), there was a 12-point drop in the global average score. With a score of 396 in 2018, Indonesia lagged below the global average of 500 on the PISA testing. These results show that scientific literacy levels in Indonesia are still below average.

Inadequate methods of teaching pupils to think critically, particularly when it comes to scientific concepts, are intrinsic to the widespread lack of scientific literacy. Students should be able to grasp science in context, not only in terms of facts, hypotheses, and principles, but also in terms of the process of discovery and their practical applications; this is why scientific education should form the bedrock of any good education system. (Kidman & Fensham, 2020). Science learning focuses on the development of real professionalism for students, enabling them to explore and understand the natural environment through a process of discovery, so that they can gain direct experience related to the world around them (Irsan, 2021). Science learning must be designed to be effective, enjoyable, and oriented towards solving problems related to natural phenomena. In the process, students need to be actively involved by observing and solving problems independently through reading and writing activities (Laila Sa et al., 2022). Improving students' scientific literacy is crucial so that they can understand the scientific process and the impact of technological developments, which are growing in complexity in tandem with the quantity and depth of scientific understanding (Washburn et al., 2023).

The approach in science learning emphasizes scientific methods that not only produce scientific products through experiments but also shape scientific attitudes in students. Therefore, they must be active in conducting experiments, observations, and trials, which will ultimately instill scientific attitudes and awareness to maintain environmental balance and sustainability (Sulthon, 2017). Pertiwi and Rusyda Firdausi (2019) assert that science education is designed to enhance students' scientific literacy via intentional planning and strategies. Sutrisna (2021) asserts that the main objective of science education is to enhance students' scientific literacy. Likewise, educational frameworks like the Merdeka Curriculum, which advocates for competency-based education and the development of students' scientific character, should guide the teaching of science. The Merdeka Curriculum itself has been implemented since 2022 as a replacement for the K13 curriculum. This curriculum change was not without reason. The curriculum change was carried out because the curriculum was considered no longer relevant to current conditions. The need for innovation in every learning process in the 21st century is no longer something special, a situation based on the rapid changes occurring in the 21st century, making educational transformation a requirement that must be met (Midun & Sanjung, 2023). Therefore, the education curriculum must be dynamic and able to respond to the challenges of the 21st century (Arvisais & Guidère, 2020). According to Syahputra (2024) the Merdeka Curriculum is a curriculum that emphasizes 21st-century needs such as 4C skills and abilities (Collaboration, Critical thinking, Communication, and Creativity).

The Ministry of Education, Culture, Research, and Technology (Kemdikbud) highlights that the Merdeka Curriculum has the advantage of focusing on essential material and developing student competencies according to their stage. This approach allows for a more in depth, meaningful, and enjoyable learning process without excessive time pressure (Rahmadayanti & Hartoyo, 2022). Project-based learning makes the learning process more meaningful and participatory because it involves students in studying real issues, such as the environment and health, while strengthening character building and competencies in accordance with the Pancasila Student Profile. This curriculum aims to improve students' literacy and numeracy, while deepening their understanding in various subjects, including science (Zulham et al., 2024). The phases or levels of development in this curriculum refer to the learning outcomes that students must achieve, which have been adjusted to their characteristics, potential, and needs. In its implementation, educators need to systematically review the application of the Merdeka Curriculum in terms of preparation, process, and outcomes. Evaluation plays a crucial role in examining whether curriculum objectives are translated into meaningful learning practices and measurable student competencies (Taş & Duman, 2021). For scientific literacy, which includes not only comprehending scientific concepts but also being able to evaluate evidence, put knowledge into practice, and make well-informed decisions based on scientific understanding, this is of utmost importance.. Such multidimensional competencies cannot be assumed to develop solely through curriculum reform; they require careful monitoring of alignment between curriculum design, instructional practices, and student outcomes. Without systematic evaluation, it would be difficult to determine whether the execution of the Merdeka Curriculum genuinely supports the development of students' scientific literacy or merely reflects procedural compliance. Therefore, this study focuses on evaluating the execution of the Merdeka Curriculum in science learning to analyze how far it supports the achievement of scientific literacy skills and to identify contextual, instructional, and institutional factors influencing its implementation in the classroom.

Based on the literature review that has been analyzed, various previous studies have evaluated the execution of the Merdeka Curriculum in various aspects and subjects. For example, a study conducted in high schools in North Aceh shows that the implementation of this curriculum is effective in developing students' job skills and scientific literacy by utilizing authentic self-assessment (Muliaman et al., 2022). Meanwhile, another study using the CIPP evaluation model in IPAS learning at Madrasah Ibtidaiyah showed that the learning resources used were sufficient to support the effectiveness of the curriculum (Mutaqin et al., 2024). Evaluations of other subjects, such as Indonesian Language and Physical Education, also found that the execution of the Merdeka Curriculum was generally going well, despite certain obstacles (Adji & Shufa, 2024; Waruwu et al., 2024). In addition, studies using a quantitative approach show that the Merdeka Curriculum contributes to a significant improvement in student learning achievement (Herianty et al., 2024). Despite these contributions, prior research has largely examined the Merdeka Curriculum in broad terms, focusing on general achievement outcomes, teacher perceptions, or curriculum management practices (Adji & Shufa, 2024; Herianty et al., 2024). Limited attention has been given to analyzing its implementation specifically in science learning through the lens of students' scientific literacy as a multidimensional competency encompassing conceptual understanding, inquiry skills, and evidence-based reasoning. Furthermore, few studies have employed a comprehensive evaluation framework that systematically links contextual readiness, resource support, instructional processes, and measurable student outcomes within a single analytical model.

This limitation is particularly significant at the current stage of nationwide curriculum implementation, where schools are transitioning toward literacy-oriented and inquiry-based pedagogical approaches. Variations in teacher readiness, institutional capacity, and instructional adaptation may influence how curriculum principles are enacted in science classrooms. Without a structured and multidimensional evaluation, it remains unclear whether gaps in students' scientific literacy originate from contextual constraints, insufficient inputs, instructional practices, or outcome-level factors. Therefore, a comprehensive evaluation is urgently needed to provide evidence-based feedback for ongoing curriculum refinement. To address this gap, this study employs the CIPP evaluation model to offer an integrated analysis of how the Merdeka Curriculum is executed in junior high school science learning and how this implementation relates to students' scientific literacy levels. By combining quantitative measurement of literacy outcomes with qualitative evaluation across context, input, process, and product dimensions, this research contributes a systematic and multidimensional evaluation that connects curriculum policy implementation with classroom practice and measurable literacy performance. Accordingly, this study addresses the following research questions: (1) What is the level of students' scientific literacy under this implementation? and (2) How is the Merdeka Curriculum implemented in junior high school science learning across the context, input, process, and product dimensions?

2. METHOD

2.1. Research Design

This research used a sequential explanatory design based on mixed-methods methodology. Prior to conducting the qualitative phase, which systematically evaluated the implementation of the Merdeka Curriculum using the CIPP model, the quantitative phase was used to assess students' scientific literacy. Each component of the CIPP framework was evaluated using well-defined variables (Table 1) and the research approach is shown in Figure 1. This was done in accordance with the assessment indicators suggested by Stufflebeam and Coryn (2014).

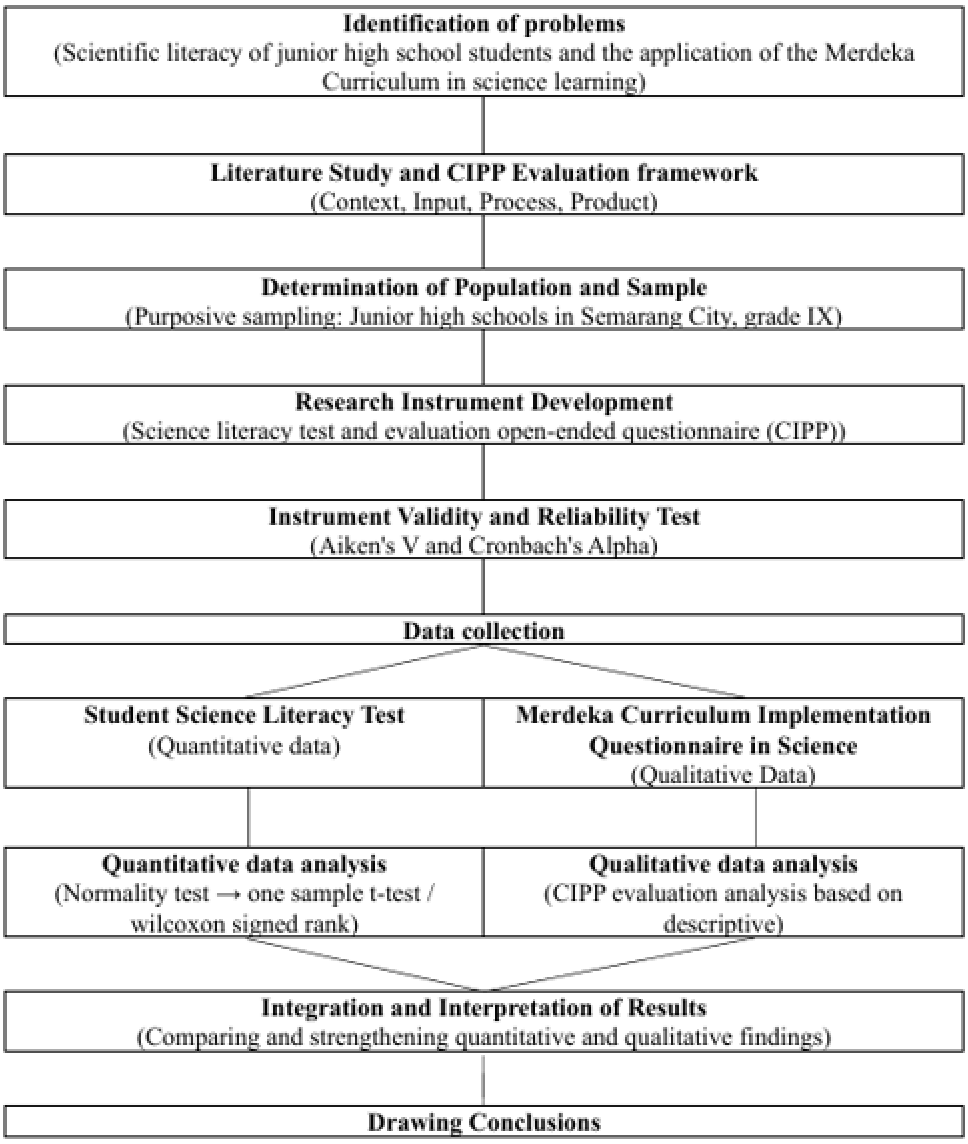

Figure 1. Research flow

Table 1. CIPP Evaluation Components and Indicators

Component	Indicator
Context	Target population needs Major implementation problems Local assets and potential Alignment with program objectives
Input	Resource availability (time, funding, human resources) Program feasibility and planning effectiveness Alternative instructional strategies
Process	Compliance with instructional plans Documentation and monitoring practices Feedback mechanisms
Product	Achievement of program objectives and impact Impact on target groups Sustainability and scalability

2.2. Time, Place, Population, Sample, and Instruments

This research was carried out from January to February 2026 at four intentionally chosen junior high schools in Semarang City. The participants were 105 Grade IX students who undertook the scientific literacy assessment and science instructors who completed the CIPP-based evaluation questionnaire. The scientific literacy assessment was formulated based on scientific literacy criteria, specifically the ability to explain phenomena scientifically, design and assess scientific investigations, critically interpret data and evidence, and analyze, evaluate, and apply scientific information for decision-making and action. Content validity was evaluated by expert judgment with Aiken's V, with all test items attaining coefficients > 0.92, indicating robust content validity. The reliability assessment with Cronbach's Alpha produced a coefficient above 0.70. The CIPP assessment questionnaire was developed using operational indicators for the context, input, process, and product components. The tool had Likert-scale items and open-ended questions aimed at eliciting instructors' perspectives and implementation techniques..

2.3. Data Analysis Technique

Quantitative data from the scientific literacy test were analyzed using the One-Sample Wilcoxon Signed-Rank Test with a benchmark score of 84 as the reference value. The benchmark score was determined based on the scientific literacy classification framework proposed by Rezeqi and Gultom (2023), in which scores ≥84 represent the multidimensional scientific literacy category. This area is characterized by a holistic understanding of science that takes into account the social, historical, and philosophical aspects of scientific and technological progress. Science at this level is about more than just memorizing facts and figures; it's also about thinking critically about the nature of science and how to apply what they've learned in real-world situations. The Wilcoxon test was therefore conducted to examine whether students' scientific literacy performance had statistically reached the multidimensional level as defined by Rezeqi and Gultom (2023). Qualitative questionnaire data were analyzed descriptively according to each CIPP component, and the findings from both phases were integrated during the interpretation stage to examine the alignment between curriculum implementation and students' scientific literacy levels.

3. RESULTS AND DISCUSSION

3.1. The Effectiveness of the Merdeka Curriculum in Science Learning on Students' Scientific literacy Skills

The assessment of the effectiveness of the Merdeka Curriculum in science learning on the scientific literacy of junior high school students was conducted by referring to the criteria for scientific literacy ability intervals presented in Table 2 and Table 3. Based on these criteria, scientific literacy skills are classified into five categories, namely conceptual scientific literacy, nominal scientific literacy, multidimensional scientific literacy, scientific illiteracy, functional scientific literacy (Rezeqi & Gultom, 2023). The descriptions for each category of scientific literacy are shown in Table 3.

Table 2. Criteria for Scientific literacy Ability Intervals.

Value Interval	Scientific literacy Category
84.0-100	Multidimensional Scientific Literacy
68.0-83.9	Conceptual Scientific Literacy
52.0-67.9	Functional Scientific Literacy
36.0-51.9	Nominal Scientific Literacy
< 35.9	Scientific Illiteracy

Modified (Rezeqi & Gultom, 2023)

Table 3. Explanation of Scientific Literacy Categories

Scientific literacy Category	Explanation
Multidimensional scientific literacy	Has the ability to understand science comprehensively by considering philosophical, historical, and social aspects in the development of science and technology.
Conceptual scientific literacy	Can build conceptual understanding and relate it to the general framework of scientific knowledge.
Functional scientific literacy	Able to describe scientific concepts fairly accurately, although still limited in the use of terminology and depth of analysis.
Nominal scientific literacy	Can identify scientific concepts, but understanding is still inaccurate and tends to contain misconceptions.
Scientific illiteracy	Not yet able to respond to or relate to scientific issues related to science.

Based on the Wilcoxon Signed Rank test results, an Asymp. Sig. of < 0.001 was obtained, causing H_0 to be rejected. This indicates that students' scientific literacy achievements are significantly below the ideal score of 84. Table 4 shows that the students in junior high school who participated in this study do not yet have the level of scientific literacy needed to be considered multidimensionally literate.

Table 4. Results of the Test of the Effectiveness of Junior High School Students' Scientific literacy Skills

Testing Aspects	Description
Types of Statistical Tests	One Sample Wilcoxon Signed Rank Test
Number of Samples (N)	105 students
Criteria Value	84
Significance Value (Asymp. Sig.)	< 0.001
Significance Level (α)	0.05
Test Decision	H_0 rejected
Substantive Meaning	The scientific literacy ability of junior high school students has not reached the specified criteria or is less than 84

The average percentage of students' scientific literacy achievement ranged between 36–40%, placing them in the nominal scientific literacy category (36.0–51.9). This classification indicates that students are generally able to recognize basic scientific concepts but demonstrate limited conceptual integration and inaccurate reasoning when applying these concepts to contextual problems. In other words, students' understanding remains at a surface level and has not yet progressed toward functional or multidimensional literacy. From a scientific literacy perspective, this suggests that learning has not fully supported higher-order competencies such as critical reasoning, evidence evaluation, and real-world application. Similar patterns have been reported in previous studies under the Merdeka Curriculum, where improvements in literacy remain moderate and uneven (Nurlaili et al., 2023). These findings imply that curriculum reform alone does not automatically translate into improved literacy outcomes without deep pedagogical transformation in classroom practice.

3.2. Students' Scientific literacy Skills for Each Indicator

The analysis of students' scientific literacy was conducted with reference to three key indicators, including the ability to explain scientific phenomena, design and evaluate scientific investigations, interpret data and evidence, and critically utilize scientific information for decision-making (Figure 2).

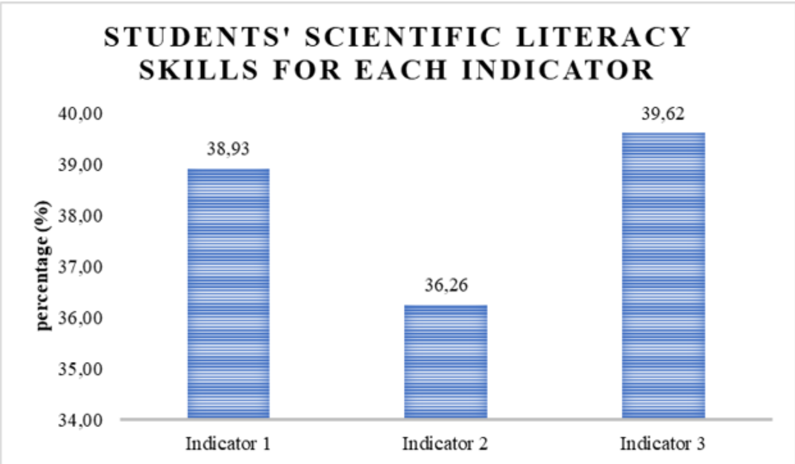

Figure 2. Junior High School Students' Scientific literacy Skills for Each Indicator (1. scientific adequacy in explaining occurrences; 2. the capacity to formulate research questions, conduct experiments, and analyze results; 3. the capacity to assess and use scientific data for decision-making)

Based on the analysis results, the average scientific literacy achievement of students reached 38.27% and was in the nominal scientific literacy category. This condition shows that the majority of students only master basic science concepts, with a shallow and incomplete understanding. This condition is in line with the results of the Wilcoxon Signed Rank Test, which shows that students' scientific literacy skills have not statistically reached the ideal criteria, so that the effectiveness of the Merdeka Curriculum on students' scientific literacy achievements is still at a moderate level. In the first indicator, Students' scientific literacy accomplishment, when it comes to describing things scientifically, was 38.93%, placing them in the nominal scientific literacy group as well. These findings show that kids can identify and explain common scientific occurrences at a basic level., but the explanations given are still descriptive and not yet fully based on integrated scientific concepts. These findings are in line with Siregar et al. (2025), who note that the Merdeka Curriculum aims to transform Indonesian education by prioritizing scientific literacy and critical thinking in science learning, but its implementation is hampered by a conventional approach that does not sufficiently involve students. This shows that the learning process still needs to be strengthened in terms of conceptual understanding and the more in-depth application of scientific knowledge. Among the indicators, the second one dealing with the development and evaluation of plans for scientific investigations and the interpretation of results, had the lowest proportion of students' scientific literacy performance at 36.26 percent and remained in the nominal scientific literacy category. This finding shows that students still have difficulty understanding the stages of scientific inquiry, reading data, and drawing conclusions based on scientific evidence. The low scores on these indicators suggest that the Merdeka Curriculum's promotion of inquiry-based and project-based learning has not been fully implemented in developing students' scientific thinking skills. These results are consistent with various studies that confirm that improvements in literacy are highly dependent on teachers' pedagogical competencies and the sustained implementation of innovative learning models that are contextual and systematically integrated (Dewi et al., 2025). Limited learning time, student readiness, and variations in teachers' abilities to manage inquiry based learning are also suspected to be factors influencing the low achievement of this indicator (Yusi & Prasetyono, 2025).

At the same time, students had the best percentage overall on the third indicator—the ability to evaluate and use scientific knowledge for decision-making and action at 39.62% although it is still in the nominal scientific literacy category. These results indicate that students are relatively more capable of using simple scientific information to assess a problem and determine a course of action, especially those related to everyday life contexts. Based on these results, it seems that the Merdeka Curriculum's contextual learning strategy is starting to help students better use scientific knowledge. (Viratama et al., 2025; Waseso et al., 2024). However, these abilities are still basic and do not fully reflect higher-level scientific literacy skills, such as critical thinking and complex evidence-based decision-making. In general, analysis of each scientific literacy indicator shows that the execution of the Merdeka Curriculum in science education has a beneficial influence on enhancing pupils' scientific literacy, although the results achieved are not yet optimal. Students' progress toward what is still considered a "nominal" level of scientific literacy, indicates that science learning has not been fully able to encourage students to reach a more functional and conceptual level of scientific literacy. Therefore, it is necessary to strengthen aspects of inquiry-based learning, the use of scientific data and evidence, and continuous teacher assistance so that the objectives of the Merdeka Curriculum in improving students' scientific literacy can be achieved more optimally.

3.3. Implementation of the Merdeka Curriculum in Science Learning in the Context Aspect

According to the findings of the context aspect questionnaire, science instructors in junior high schools believe that their students' learning requirements are met when the Merdeka Curriculum is used in scientific lessons. The majority of teachers (67%) found the curriculum to be "appropriate" for supporting scientific learning, suggesting that the Merdeka Curriculum is seen as relevant. (Figure 3). However, there were still responses from teachers who rated the curriculum as "inappropriate," indicating variations in conditions and readiness between schools. This finding is in line with Raya et al. (2025), which emphasizes that the success of the Merdeka Curriculum implementation depends on the readiness of educators and institutional support, so that the level of implementation may vary between educational units.

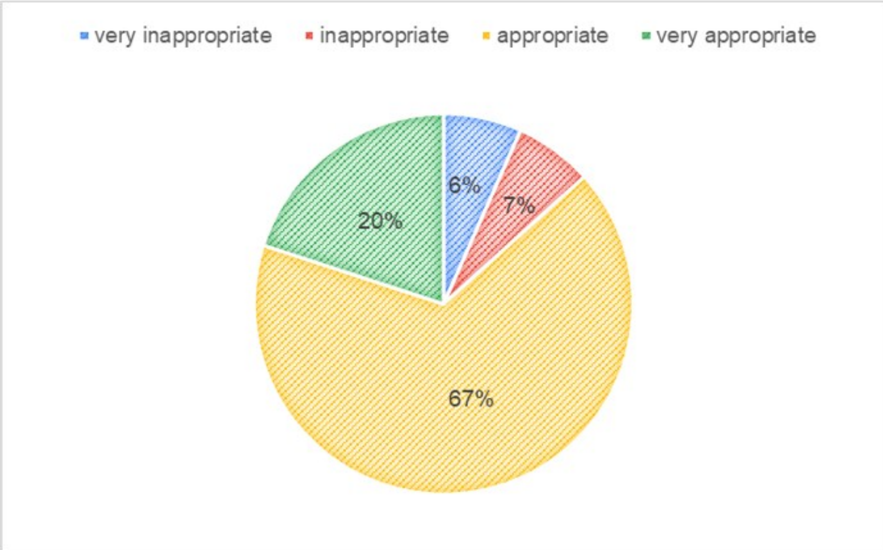

Figure 3. Teachers' Perceptions of the Suitability of the Merdeka Curriculum to Students' Learning Needs in Science Learning

In terms of stakeholder involvement, the questionnaire results show that science learning involves various parties, such as school principals, fellow teachers, parents, and school committees. This multi-stakeholder involvement is important because the successful implementation of the new curriculum depends heavily on synergy among stakeholders (Rahayuningsih & Hanif, 2024). However, this support has not been fully felt in the form of assistance that directly supports learning practices, such as intensive training, provision of learning media, and strengthening of school policies. This condition has the potential to hinder teachers in optimally implementing the principles of the Merdeka Curriculum (Rosmiati et al., 2025). The questionnaire results also revealed that science teachers' urgent needs are related to practical and applicable training and mentoring. According to the Merdeka Curriculum, educators have voiced a need for professional development in areas such as lesson plan creation, student evaluation, technology integration, and individualized instruction. (Djeni & Waluyo, 2025). Learning media, worksheet banks, and contextual teaching resources all have their limits, which further hinders the application of scientific learning.. This condition is in line with findings that show that many teachers still do not have adequate TPACK mastery so that the utilization and development of technology-based learning media cannot be implemented optimally (Dewi et al., 2024). Teachers also stated that differences in students' abilities and characters pose a challenge in learning (Figure 4). Students' dependence on gadgets and their declining curiosity further reinforce the complexity of the current science learning context (Perdiansyah & Hodijah, 2023).

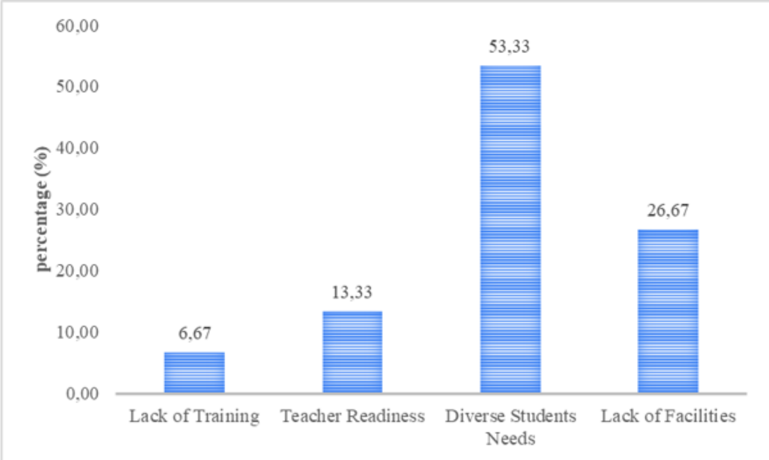

Figure 4. Main Sources of Obstacles in the Implementation of the Merdeka Curriculum in Science Learning

In utilizing local assets, most teachers have linked science learning to the surrounding environment, such as observing the school environment, rivers, gardens, and pollution issues. However, the utilization of the local context is still simple and has not been systematically integrated into learning planning (Zahro & Maulida, 2024). In fact, the planned use of the local context is believed to increase the meaningfulness of learning and students' scientific literacy (Delimanugari, 2025; Indiyani et al., 2024). Overall, the context aspect shows that the Merdeka Curriculum is conceptually aligned with the needs of scientific literacy and the Pancasila Student Profile (Waseso et al., 2024), but limitations in teacher readiness, system support, and school conditions remain the main factors limiting its optimal implementation.

3.4. Application of the Merdeka Curriculum in Science Learning in the Input Aspect

In the CIPP model, the input aspect focuses on resource readiness, planning, and strategies to support the execution of the Merdeka Curriculum in science education. The questionnaire findings reveal that the majority of schools are equipped with facilities to support science education, including textbooks, practical tools, presentation devices, laboratories, and internet networks. These facilities contribute significantly to students' understanding of concepts and the success of the learning process (Anjiana et al., 2025). However, schools with more complete facilities tend to show better learning outcomes, in line with findings that investment in educational facilities is positively correlated with student achievement (Thonisiata et al., 2024). In terms of teacher competency development, most respondents stated that they had participated in Merdeka Curriculum training during the 2023–2025 period. This indicates ongoing efforts to improve teachers' understanding of the new curriculum. Well-designed training can improve teachers' ability to implement contextual learning more effectively (Mujianto et al., 2025). However, when linked to the findings on context, many teachers still stated that they needed additional training that was more practical and applicable. This condition indicates that in terms of quantity, the training is relatively adequate, but in terms of quality and depth, the training has not fully addressed the real needs of teachers in differentiated learning, inquiry, and assessment development. Regarding lesson planning, all respondents considered the science learning outcomes in the Merdeka Curriculum to be appropriate. However, teachers' perceptions of the ease of understanding and applying CP, TP, and ATP varied, with some teachers still experiencing difficulties (Table 5). This is in line with the findings of Ali & Susilawati (2024), who stated that although teachers are able to compile teaching modules, they still experience obstacles in formulating and translating ATP into concrete learning activities. These differences in comprehension levels can lead to inconsistencies and uneven quality in science learning planning in the classroom.

Table 5. Teachers' Perceptions of the Ease of Understanding and Applying CP, TP, and ATP in Science Learning

Ease of Understanding and Applying CP, TP and ATP	
Agree	**Don't agree**
80%	20%

In developing teaching modules and learning strategies, teachers tend to combine various sources, such as MGMP modules, adaptations from the Ministry of Education and Culture, and online references. This pattern shows that teachers are independent in developing teaching materials and adapting them to students' needs (Nisak et al., 2024). However, these results are consistent with research showing that science teachers' ability to develop innovative learning modules based on the integration of pedagogy and technology is still not optimal due to limited mastery of TPACK (Dewi et al., 2023). In terms of learning strategies, teachers reported using various approaches, such as PBL, project-based learning, discovery-based learning, simple experiments, group discussions, and technology-based learning (Figure 5).

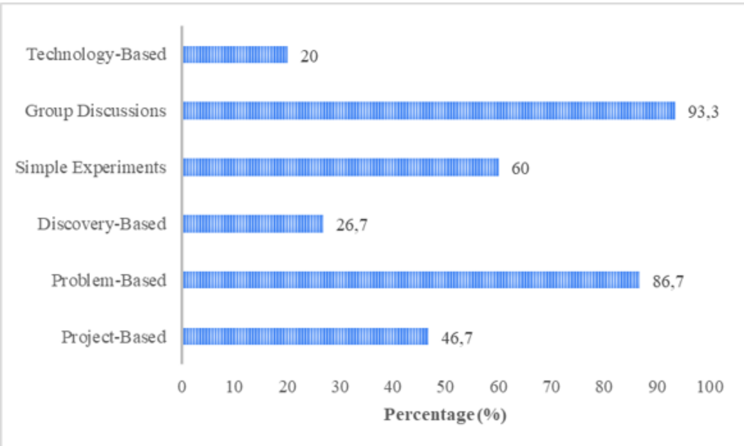

Figure 5. Science Learning Strategies Used by Teachers in the Implementation of the Merdeka Curriculum

However, the application of these strategies has not been fully optimized due to constraints related to teacher readiness, time limitations, and school support. Thus, the input aspect shows that although learning resources and planning are available, their quality and suitability to classroom needs still need to be strengthened so that the execution of the Merdeka Curriculum can be more effective.

3.5. Implementation of the Merdeka Curriculum in Science Learning in the Process Aspect

The process aspect in the CIPP model focuses on the implementation of the Merdeka Curriculum in science learning, including compliance with planning, application of learning strategies, and monitoring and feedback mechanisms. Based on the questionnaire results, teachers strive to implement various learning approaches recommended in the Merdeka Curriculum, including PBL, project-based learning, and discovery learning. These approaches have been proven to increase student engagement, critical thinking skills, creativity, and scientific literacy (Yusi & Prasetyono, 2025). The frequency of strategy implementation was in the moderate to frequent category, indicating that teachers are making an effort to adapt to new learning approaches. However, the consistency of the implementation of learning strategies still varies among teachers. This variation is influenced by time constraints, classroom management constraints, teacher readiness, and uneven school support (Yusi & Prasetyono, 2025). In addition, although the majority of teachers stated that teaching had been carried out in accordance with the ATP and teaching modules, the differences in scores indicate that some teachers have not been able to implement teaching consistently according to plan. This condition is in line with the findings of Prihatien et al. (2023), which indicates that educators still face obstacles in understanding CP, designing ATP, and developing teaching modules to their full potential.

In terms of monitoring and evaluation, all respondents stated that science learning evaluation was carried out periodically through formative and summative assessments, evaluation of each learning objective, and supervision by the principal or senior teachers. Continuous formative assessment helps teachers monitor student learning progress, while summative assessment serves to evaluate final learning outcomes (Akbar et al., 2025). The existence of routine supervision and evaluation shows that the implementation of the Merdeka Curriculum in science learning has an effective monitoring mechanism. However, the practice of learning reflection still shows variations in frequency and has not been carried out consistently by all teachers. Some teachers reflect after completing a topic or periodically, while others only do so occasionally. In fact, Reflection plays a crucial role in the ongoing enhancement of the caliber of education. (Rizqina et al., 2023). In terms of support, school principals and MGMPs serve as the main sources of support, although the quality of this support varies between schools. This reinforces the finding that school leadership has a significant effect on the successful implementation of new curricula (Khotimah & Noor, 2024). Overall, the process aspect shows that the execution of the Merdeka Curriculum in science education is underway, but it still needs to be strengthened to be more consistent and optimal.

3.6. The Implementation of the Merdeka Curriculum in Science Education in the Product Aspect

In terms of product, the CIPP evaluation emphasizes the achievements and impact of the execution of the Merdeka Curriculum in science learning on students' scientific literacy. The findings show that although teachers assessed an increase in learning outcomes and scientific literacy after the execution of the curriculum, its effectiveness was still not optimal. Statistical evidence through the Wilcoxon test shows that students' scientific literacy scores are still below the ideal standard of 84. Furthermore, the average scientific literacy achievement of 36-40% places students in the nominal scientific literacy category, which indicates that students' understanding is still limited to basic concepts and has not developed into the ability to apply and evaluate in real situations. Thus, although the Merdeka Curriculum is designed to encourage contextual and project-based learning to improve scientific literacy (Mujriati et al., 2025), the findings of this study show that its impact on students' scientific literacy is positive but not yet evenly distributed and not yet significant overall. According to teachers' perceptions, Students demonstrated a considerable progress in their scientific literacy when it came to solving contextual issues, applying scientific ideas in daily life, and mastering the scientific method.

These findings corroborate those of Waseso et al. (2024), who found that students' ability to follow the scientific method improved significantly after the implementation of the Merdeka Curriculum. Additionally, students are being encouraged to not only grasp topics conceptually but also to apply them in real-life scenarios via science instruction that is increasingly contextual and project-based. This indicates a change towards learning that is more focused on the learner and has deeper significance. (Viratama et al., 2025). However, these positive impacts have not been felt equally by all students. The questionnaire results show that the increase in interest in learning science is mostly in the "slightly increased" category, and only a small number of teachers assess that student interest has increased significantly. In fact, there are respondents who stated that students' interest in learning has not changed. In addition, most teachers assess that only about 50% of students are able to relate science learning to real life (Figure 6). These findings indicate that the execution of contextual learning has not been fully optimized in reaching all students, even though theoretically this approach is believed to be able to increase functional understanding and interest in learning science (Amelia et al., 2025).

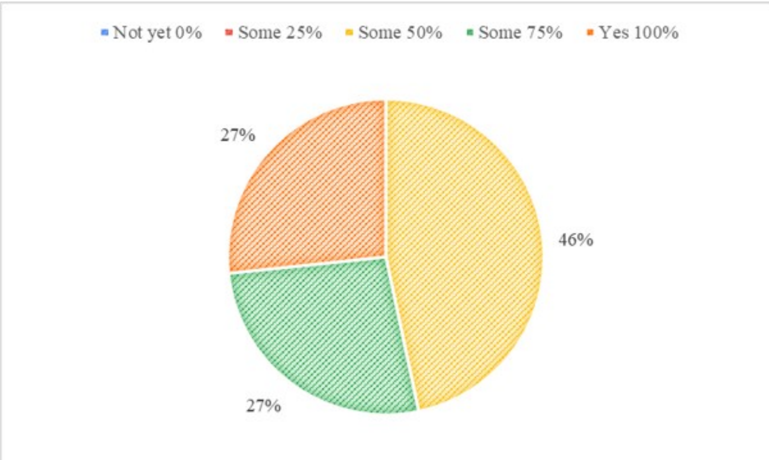

Figure 6. Percentage of Students Who Relate Science Learning to Real Life According to Teachers' Views

In terms of sustainability, the majority of teachers are committed to continuing to implement the principles of the Merdeka Curriculum in science education. However, consistency in its implementation is highly dependent on internal school policies and institutional support. Therefore, continuous support from the government and all education stakeholders plays an important role in the successful implementation of the curriculum on an ongoing basis (Wulandari et al., 2024; Yanita et al., 2024). Good practices that should be maintained include real-world phenomenon-based learning, student-centered learning, the application of PBL and inquiry, and the use of technology (Fitri & Zainil, 2025). Overall, the product aspect shows that the Merdeka Curriculum has had an initial positive impact, but process strengthening and system support are still needed to achieve more optimal and sustainable results.

3.7. Synthesis and Practical Implications of the Merdeka Curriculum on Scientific Literacy in Science Learning

The findings of this study indicate that while the Merdeka Curriculum has conceptually aligned science learning with the goal of strengthening scientific literacy, its implementation has not yet fully facilitated the development of multidimensional literacy competencies. Students' achievements remain at the nominal level, particularly in the areas of scientific investigation design and evidence-based reasoning. The CIPP analysis further suggests that variations in contextual readiness, instructional consistency, and pedagogical depth contribute to these outcomes. Based on this synthesis, several practical directions can be proposed. First, science instruction should more systematically integrate structured inquiry activities that explicitly train students in formulating research questions, analyzing data, and constructing evidence-based arguments. Second, professional development programs for teachers should focus on strengthening pedagogical competencies in facilitating higher-order scientific reasoning rather than merely implementing project-based activities at a procedural level. Third, schools should ensure alignment between curriculum planning, assessment design, and literacy objectives so that evaluation instruments measure multidimensional competencies rather than surface-level conceptual recall. Previous research has consistently emphasized that while organizing a curriculum, it is important to think about more than just how lessons are structured. Educators should also evaluate how well their goals, students' backgrounds, and cultural contexts connect with one another. (Hidayat et al., 2025). Continuous monitoring using an integrated evaluation framework such as CIPP is also recommended to identify specific areas requiring improvement at the context, input, process, and product levels. By implementing these strategies, the Merdeka Curriculum can move beyond structural reform toward substantive improvement in students' scientific literacy outcomes.

4. CONCLUSION

The research found that junior high school students' scientific literacy has not been entirely improved by implementing the Merdeka Curriculum in science teaching. Students' scientific literacy skills still fall short of the ideal threshold of 84 and have not achieved the greatest degree of scientific literacy, as shown by the results of the Wilcoxon test. The majority of students' scientific literacy accomplishments fall into the "nominal" category, meaning they can only understand basic scientific ideas and have not mastered how to apply them thoroughly for analysis, assessment, and making decisions based on evidence. However, when looking at it from a context, input, process, and product perspective, the Merdeka Curriculum in junior high scientific learning has typically been done fairly well. Teachers have developed lesson plans based on ATP and teaching modules, utilized available facilities, and applied recommended learning strategies. However, its implementation has not been entirely consistent due to time constraints, variations in teacher and student readiness, and uneven school support. Therefore, Strengthening efforts need to be focused on providing practical and ongoing teacher training, optimizing the use of learning facilities, and providing stronger school policy support so that the execution of the Merdeka Curriculum can improve students' scientific literacy in a more tangible way.

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