*Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*
*https://e-journal.undikma.ac.id/index.php/prismasains/index*
*e-mail: prismasains.pkpsm@gmail.com*

*July 2026. Vol. 14, No. 3*
*p-ISSN: 2338-4530*
*e-ISSN: 2540-7899*
*pp. 1339-1372*

# Unveiling Seventh-grade Natural Sciences Teaching Practices Under the *Merdeka* Curriculum in Pontianak, West Kalimantan

**[1]Kurnia Ningsih, [1]*Anisyah Yuniarti, [1]Mas Akhbar Faturrahman, [2]Dian Wahyuningsih**

[1]Bachelor Program of Biology Education, Faculty of Teacher Training and Education, Universitas Tanjungpura, Pontianak, Indonesia
[2]Doctoral Program of Curriculum and Instruction, Department of Educational Sciences, Kazım Karabekir Faculty of Education, Atatürk Üniversitesi, Erzurum, Türkiye

*Corresponding Author e-mail: anisyah.yuniarti@fkip.untan.ac.id

Received: April 2026; Revised: May 2026; Published: July 2026

**Abstract**

The *Merdeka* Curriculum is a systemic change aimed at addressing learning loss caused by the Coronavirus Disease 2019 pandemic. One subject largely affected by the curriculum implementation is Natural Sciences, which has undergone several changes since its inception in 2022. This research aims to examine how the implementation of the *Merdeka* Curriculum in the seventh-grade Natural Sciences subject has developed over time by comparing its initial adoption with its implementation in 2025. This research employed mixed methods and involved 30 seventh-grade Natural Sciences teachers from junior high schools in Pontianak City, West Kalimantan Province, Indonesia. Data collection involved questionnaires and brief interviews in 2023 and 2025, concluding in quantitative and qualitative data analysis. The research unveiled comprehensive information, mapped into five key aspects of implementing Natural Sciences learning in the *Merdeka* Curriculum: the subject's basis and duration, teachers' perceptions and understanding, planning and implementation of the learning, assessment of the learning, and its impacts. Several notable key quantitative findings were revealed. First, the proportion of schools that implemented the *Merdeka* Curriculum rose from 93.3% in 2023 to 100.0% in 2025. Second, teachers who utilized four learning models in 2023 began diversifying their choices, with the 2025 data showing five models, with problem-based learning gaining the highest proportion (76.7%). Third, the collaboration among Natural Sciences teachers and other subjects has risen in proportion from 46.7% for both in 2023 to 86.7% and 76.7% in 2025, respectively. Fourth, the proportion of teachers who felt positive impacts from the *Merdeka* Curriculum rose from 93.3% in 2023 to 100.0% in 2025. Fifth, there is a decrease in the proportion of teachers who faced obstacles in implementing the *Merdeka* Curriculum—from 90.0% in 2023 to 66.7% in 2025. Moreover, qualitative findings enrich the quantitative data by providing insights into how seventh-grade Natural Sciences teachers perceive the *Merdeka* Curriculum and how they translate the regulations into classroom practices, thereby supporting students' further development in line with national and global demands. Overall, the results indicate that the seventh-grade Natural Sciences teachers in Pontianak City perceive the *Merdeka* Curriculum as a primary nationwide educational framework that substantially improves teachers' competencies and supports student development, particularly in character development and 21st-century skills. However, several issues in curriculum implementation require further action and research.

**Keywords:** Crisis of learning; Curriculum reform; *Merdeka* curriculum; Natural sciences; Teaching practices

**How to Cite:** Ningsih, K., Yuniarti, A., Faturrahman, M. A., & Wahyuningsih, D. (2026). Unveiling Seventh-grade Natural Sciences Teaching Practices Under the Merdeka Curriculum in Pontianak, West Kalimantan. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *14*(3), 1339–1372. https://doi.org/10.33394/j-ps.v14i3.20286

https://doi.org/10.33394/j-ps.v14i3.20286

Copyright© 2026, Ningsih et al.
This is an open-access article under the CC-BY License

## INTRODUCTION

Various national and international research shows that Indonesia has been experiencing a learning crisis for a long time (Barjum, 2022; Bilad et al., 2024; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). The learning profile in Indonesia analyzed by Beatty et al. (2021) revealed that the average seventh-grade student in 2014 had

learned as much as the average fourth-grade student in 2000. Susanti et al. (2025) concluded that between 2000 and 2018, Indonesia consistently ranked in the lowest ten in the Programme for International Student Assessment (PISA) initiated by the Organisation for Economic Co-operation and Development (OECD), displaying a hump-shaped trend in language, mathematics, and science. The most recent PISA assessment, conducted in 2022 and marking the eighth round of PISA implementation, shows that the average achievement of Indonesian students has declined compared to the results obtained in 2018, yielding one of the lowest results since the assessment's inception (OECD, 2023). Rosser et al. (2022) argue that Indonesia's learning crisis is fundamentally rooted in politics, more specifically in the predatory domination of political elites, bureaucracy, and corporations during the New Order and post-New Order periods. The ongoing learning crisis has undoubtedly had negative impacts on the sustainability of the Indonesian nation. One negative impact is learning loss.

Learning loss is a condition in which students experience a decline in academic knowledge and skills, often associated with a loss of motivation to learn and drastic changes in the learning process (Maba et al., 2023; Pek et al., 2024; Zhdanov et al., 2022). Learning loss leaves many Indonesian children unable to understand simple reading or apply basic math concepts (Susanti et al., 2025). This condition is exacerbated by the Coronavirus Disease 2019 (COVID-19) pandemic (Engzell et al., 2021; Haser et al., 2022). The COVID-19 pandemic triggered school closures in more than 100 countries since March 2020, affecting over 800 million children worldwide and prompting schools to implement online learning to reduce virus transmission (Suyadi et al., 2023; Viner et al., 2020). A meta-analysis by Wisenöcker et al. (2025) indicates that school closures due to COVID-19 have led to significant learning loss, with effects persisting across most phases of the pandemic. Furthermore, Donnelly & Patrinos (2022) reported that several research show an increase in the educational gap, where certain student demographics experience greater learning loss. Therefore, systemic changes are needed to overcome the crisis and challenges in education through curriculum changes. The current curriculum in Indonesia is the *Merdeka* Curriculum.

The *Merdeka* Curriculum is expected to improve students' learning processes, which were disrupted by online learning during the COVID-19 pandemic. The *Merdeka* Curriculum is flexible by focusing the learning process on essential topics, skills, and character development (Saa, 2024; N. E. Wardani et al., 2025). Moreover, the *Merdeka* Curriculum emphasizes a student-centered approach, tailored to students' needs to support enjoyable and meaningful learning activities (Fauziah et al., 2023; Permanasari et al., 2024). Therefore, teachers are encouraged to design innovative, active, and creative learning activities to accommodate students' needs, in line with the philosophy of the *Merdeka* Curriculum (Maylawati et al., 2025). Given that the *Merdeka* Curriculum has been introduced gradually, starting in 2022 and continuously evolving in practice, it is important to understand how its implementation unfolds over time. This temporal-comparative perspective is important for reviewing teacher readiness, support from the school system, and guidance from regulations governing the implementation of the *Merdeka* Curriculum, which undoubtedly influence how the curriculum is implemented over time compared to its initial adoption. In addition, changes in the curriculum can create particular challenges, such as instability in the education system and a decline in student achievement, leading to heterogeneous effects on holistic learning outcomes across preparation levels (Andrietti & Su, 2019). Aygören & Er (2019) state that the curriculum must be evaluated periodically to ensure it meets the school's needs and maintains continuity.

This research focuses on the Natural Sciences subject. The Natural Sciences subject explores natural phenomena through theoretical and experimental approaches (Frigerio et al., 2021), encompassing four fields of study: biology, physics, chemistry, as well as earth and space (Dawson et al., 2022; Islami et al., 2022). The Natural Sciences subject serves as a strategic vehicle for supporting students' cognitive, affective, and psychomotor development.

Through the particular subject, students learn about the universe in ways that build faith, moral character, and curiosity. In addition, the science process skills embedded in the subject are expected to improve students' learning outcomes and the 21st-century skills that are urgent to master. Moreover, the Natural Sciences subject plays a strategic role in shaping students into independent, collaborative, and globally aware individuals who can identify local and global problems through various scientific lenses. This is supported by Hogan & O'Flaherty (2022), who argue that many of the central concepts and methods in the Natural Sciences subject offer particular lenses through which students can consider the development challenges represented within the Sustainable Development Goals. Therefore, inadequate implementation of the subject can directly hinder students' development, which is critical to address Indonesia's persistent learning crisis. The choice of seventh-grade Natural Sciences is made because it is a critical entry point, marking students' first formal exposure to the subject and emphasizing a strong scientific and multidisciplinary conceptual understanding and skills at the secondary school level. The way teachers introduce fundamental concepts, scientific thinking, and learning routines in this transitional year considerably affects students' subsequent learning trajectories. Furthermore, the *Merdeka* Curriculum regulations in junior high schools have been determined to be implemented gradually, starting with seventh-grade students.

The Education Standards, Curriculum and Assessment Agency of the Republic of Indonesia (*Badan Standar, Kurikulum, dan Asesmen Pendidikan Republik Indonesia* [BSKAP RI], 2022) issued a Decree Number 044/H/KR/2022 concerning Schools Implementing the *Merdeka* Curriculum in the 2022/2023 Academic Year. Based on the decree, the BSKAP RI determined that more than 140,000 schools will implement the *Merdeka* Curriculum in the 2022/2023 academic year, including 40 state and private junior high schools in Pontianak City. However, information on the implementation of the *Merdeka* Curriculum in the seventh-grade Natural Sciences subject in Pontianak City remains limited. Several research related to the implementation of the *Merdeka* Curriculum in Pontianak City have been conducted, including those by Angela et al. (2024), Firdaus et al. (2024), and Ramadhan et al. (2024). However, no research has examined how the *Merdeka* Curriculum is implemented in junior high schools, specifically in the seventh-grade Natural Sciences subject. Attention to how Natural Sciences teachers interpret and translate the principles of the *Merdeka* Curriculum into various classroom practices, such as lesson planning and assessment design, remains very limited. Furthermore, the regulations of the *Merdeka* Curriculum, which have undergone continuous changes from inception to the present as explained previously, undoubtedly pose certain challenges and obstacles for teachers in optimally implementing the *Merdeka* Curriculum, thereby emphasizing the urgency of this research. Therefore, a comprehensive understanding of seventh-grade Natural Sciences teaching practices under the *Merdeka* Curriculum through periodic evaluation, especially in the context of Pontianak City, is needed to examine teachers' sensemaking in the current curriculum in Indonesia.

Based on the background elaborated, this research aims to specifically examine how the implementation of the *Merdeka* Curriculum in the seventh-grade Natural Sciences subject has developed over time by comparing its implementation at the time of initial application and at present. This research was conducted to address five particular research questions (RQs): "What are the basis and duration of Natural Sciences subject implementation under the *Merdeka* Curriculum?" (RQ1), "How do teachers perceive and understand the *Merdeka* Curriculum in the context of Natural Sciences learning?" (RQ2), "How do teachers plan and implement Natural Sciences learning under the *Merdeka* Curriculum?" (RQ3), "How do teachers assess students' learning in Natural Sciences under the *Merdeka* Curriculum?" (RQ4), and "What impacts does the *Merdeka* Curriculum have on Natural Sciences learning?" (RQ5). This research offers novelty by being the first to analyze the implementation of the *Merdeka* Curriculum in the Natural Sciences subject in Pontianak City, assessed in 2023 as the initial adoption phase and in 2025 as the current implementation phase. Specifically, this research

examines the *Merdeka* Curriculum implementation in the seventh-grade Natural Sciences subject through five interconnected dimensions based on the RQs formulated: curriculum structure and learning duration, teachers' extension of understanding the curriculum, learning planning and implementation, assessment practices, and perceived impacts on learning. The temporal-comparative perspective adopted by this research emphasizes the evaluation of curriculum implementation and the identification of changes, adaptations, and ongoing challenges in the *Merdeka* Curriculum enactment that are impossible to capture through single-period research. This research contributes to evaluating the trajectory and progress of the *Merdeka* Curriculum implementation and provides insights for improving Natural Sciences learning practices in junior high schools.

## METHOD

### Research Design

This research is classified as mixed methods. Mixed-methods research harmoniously integrates quantitative and qualitative methods, providing a better framework for examining complex problems (Bakhsh et al., 2024). The design used in this research is embedded, allowing simultaneous quantitative and qualitative data collection—quantitative results are emphasized but supported by qualitative data (Muraleedharan et al., 2022). Through embedded design, this research provides a comprehensive understanding of how the *Merdeka* Curriculum is applied in the seventh-grade Natural Sciences subject, both quantitatively through data on implementation levels and qualitatively through teachers' remarks. This research was conducted in Pontianak City, West Kalimantan Province, Indonesia, from February 2023 to October 2025. The approach employed in this research is a repeated cross-section conducted in 2023 and 2025, in which data from both years were intended solely to describe changes in overall implementation patterns and teachers' perceptions at the population level, rather than at the individual teacher level, while accounting for personnel attrition in schools. This approach enabled this research to examine how the implementation of the *Merdeka* Curriculum in the context of the seventh-grade Natural Sciences subject in Pontianak City evolved across different phases of adoption. Overall, the research flow is presented in Figure 1.

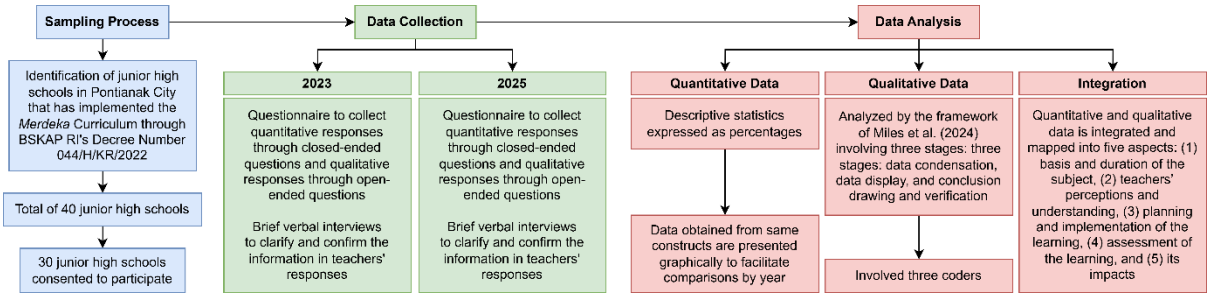



**Figure 1**. Research flow

### Population and Sample

The population of this research is the state and private junior high schools in Pontianak City. The sampling technique used in this research is purposive sampling. The particular technique was selected to ensure that the respondents met the specific criteria necessary to evaluate the implementation of the *Merdeka* Curriculum, specifically the seventh-grade Natural Sciences teachers in junior high schools determined in the BSKAP RI's (2022) Decree Number 044/H/KR/2022 as schools that have implemented the *Merdeka* Curriculum in the 2022/2023 academic year. While the initial target consists of 40 schools explicitly listed in the decree, only 30 schools have been consented to participate as respondents in this research after being observed and granted research permits. Comprising 30 teachers from 21 state and 9 private junior high schools, the demographic data of the respondents are presented in Table 1.

**Table 1**. Demographic data of the respondents

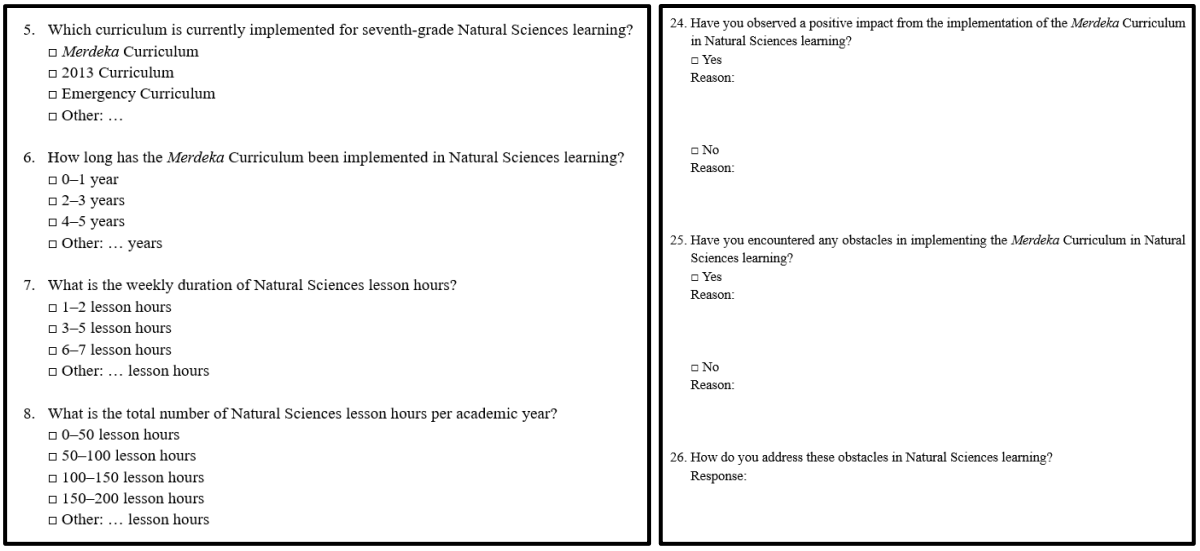
| No. | Criterion | Group | Frequency of Respondents | |
|---|---|---|---|---|
| | | | 2023 | 2025 |
| 1 | Gender | Female | 23 (76.7%) | 24 (80.0%) |
| | | Male | 7 (23.3%) | 6 (20.0%) |
| 2 | Age | <30 | 8 (26.7%) | 7 (23.3%) |
| | | 30–40 | 4 (13.3%) | 7 (23.3%) |
| | | 40–50 | 9 (30.0%) | 9 (30.0%) |
| | | >50 | 9 (30.0%) | 7 (23.3%) |
| 3 | Level of education | Diploma degree | 2 (6.7%) | 0 (0.0%) |
| | | Bachelor's degree | 28 (93.3%) | 30 (100.0%) |
| 4 | Work tenure | <6 years | 10 (33.3%) | 12 (40.0%) |
| | | 6–10 years | 2 (6.7%) | 1 (3.3%) |
| | | 11–15 years | 7 (23.3%) | 7 (23.3%) |
| | | 16–20 years | 3 (10.0%) | 3 (10.0%) |
| | | >20 years | 8 (26.7%) | 7 (23.3%) |

## Data Collection Techniques

The data for this research were collected using two paper-based questionnaires administered directly to respondents at different times. The 2023 questionnaire consisted of 14 items, while the 2025 questionnaire was expanded to 28 items. As the sole instrument utilized to examine the development of the implementation of the *Merdeka* Curriculum in the seventh-grade Natural Sciences subject through a temporal-comparative perspective, the questionnaire underwent an expansion in 2025 on the number of items to capture the increasingly complex dynamics of the *Merdeka* Curriculum and the assumed variations in the seventh-grade Natural Sciences teaching practices, thereby providing a more comprehensive and in-depth understanding. Both questionnaires included closed-ended questions to gather quantitative data on curriculum implementation levels and open-ended questions to capture qualitative data about teachers' experiences, challenges, and improvements over time. The grids for both questionnaires are shown in Table 2, and examples of the items are shown in Figure 2. In addition to the questionnaires, brief verbal interviews were conducted with respondents to clarify and confirm the information in their responses, ensuring the validity and reliability of the responses obtained from the questionnaires. Further steps are taken through peer debriefing, which involves discussions and cross-checking with the research team members to reach a consensus on the data analysis.

**Table 2**. Grid of the questionnaires utilized in 2023 and 2025

| No. | Aspect | Item Number | |
|---|---|---|---|
| | | 2023 | 2025 |
| 1 | Foundations for delivering Natural Sciences learning | 1–9 | 1–9 |
| 2 | Teachers' comprehension of the *Merdeka* Curriculum | - | 10–12 |
| 3 | Preparation and execution of Natural Sciences learning | 13–14 | 13–18 |
| 4 | Assessment of Natural Sciences learning | - | 19–21 |
| 5 | Development of students' in Natural Sciences learning | - | 22–23 |
| 6 | Impacts of the *Merdeka* Curriculum | 10–12 | 24–26 |
| 7 | Evaluation and future expectations | - | 27–28 |
| **Total Number of Items** | | 14 items | 28 items |




(a) (b)

**Figure 2**. Example of the items (taken from the 2025 questionnaire) regarding (a) foundations for delivering Natural Sciences learning and (b) impacts of the *Merdeka* Curriculum

The items already present in the 2023 questionnaire were retained in the 2025 version, preserving core construct continuity across the two implementation phases. Table 3 presents the mapping of the same constructs in the 2023 and 2025 questionnaires, indicating which items were retained for cross-year comparison purposes. However, the items regarding students' achievement on learning outcomes and activities in 2023 and 2024, as part of the "Assessment of Natural Sciences Learning" aspect, were derived from teachers' perceptions collected through the 2025 questionnaire. This is considering that the implementation of the *Merdeka* Curriculum became more established in 2025; therefore, expanding the 2025 questionnaire to explore teachers' perceptions of the *Merdeka* Curriculum's influence on students' achievement.

**Table 3**. Mapping of the same constructs and item numbers for cross-year comparisons

| No. | Aspect | Construct | Item Number | |
|---|---|---|---|---|
| | | | 2023 | 2025 |
| 1 | Foundations for delivering Natural Sciences learning | Distribution of curriculum frame-works | 5 | 5 |
| | | Distribution of lesson hours per week | 7 | 7 |
| | | Distribution of lesson hours per semester | 9 | 9 |
| 2 | Preparation and execution of Natural Sciences learning | Learning models | 13.b.2 | 15 |
| | | Collaboration among Natural Sciences teachers | 13.b.3 | 17 |
| | | Collaboration with other subjects | 13.b.4 | 18 |
| 3 | Impacts of the *Merdeka* Curriculum | Positive impacts of the *Merdeka* Curriculum | 10 | 24 |
| | | Obstacles faced in implementing the *Merdeka* Curriculum | 11–12 | 25–26 |

Before use, the feasibility of both questionnaires was assessed through content validity and interrater reliability. The content validation process involved five Biology Education lecturers at Universitas Tanjungpura, selected for their expertise in educational and curriculum development research. The number of validators was based on the recommendation by Almanasreh et al. (2019), who stated that the minimum number of validators in a content validation process should be five. The content validation process was conducted using a questionnaire validation sheet comprising three aspects: construction, content, and language, with each aspect consisting of 6 criteria, totalling 18 criteria. The validation process used a 95% confidence level, five validators, and a four-point Likert scale (1 = poor, 2 = fair, 3 =

good, and 4 = very good). The results of the content validity (through Aiken's [1985] validity index) and interrater reliability (through Intraclass Correlation Coefficient test in Statistical Product and Service Solutions version 27) are presented in Table 4. The content validity and interrater reliability values indicate that the questionnaires used in this research are feasible. The questionnaires are then revised based on each validator's input.

**Table 4**. Feasibility of the questionnaires utilized in 2023 and 2025

| No. | Aspect | Year | | | |
|---|---|---|---|---|---|
| | | 2023 | | 2025 | |
| | | Value | Category | Value | Category |
| 1 | Content Validity [a] | 0.98 | Valid | 0.97 | Valid |
| 2 | Interrater Reliability [b] | 0.876 | Good | 0.821 | Good |

[a] Using a threshold of 0.87 by the rules of Aiken's (1985) validity index
[b] Using a two-way mixed model with absolute agreement according to the categories proposed by Koo & Li (2016)

## Data Analysis Techniques

### *Quantitative Data Analysis*

Quantitative data were analyzed using descriptive statistics expressed as percentages. Comparative analyses between the 2023 and 2025 data were conducted only on questionnaire items that produce the same type of data to maintain construct comparability (as previously shown in Table 2). Additional items introduced in the 2025 questionnaire were analyzed descriptively and were used to provide broader contextual insights regarding the implementation of the *Merdeka* Curriculum, but were not used for direct cross-year comparisons (except for the items regarding students' achievement on learning outcomes and activities that present the percentages from 2023 and 2024 based on teachers' perceptions).

### *Qualitative Data Analysis*

Qualitative data were analyzed following the framework of Miles et al. (2014), which consists of three stages: data condensation, data display, and conclusion drawing and verification. The qualitative data analysis primarily employed a thematic content analysis approach to identify patterns related to the implementation of the *Merdeka* Curriculum in seventh-grade Natural Sciences in Pontianak City, based on the research questions formulated. In other words, the unit of analyses consisted of teachers' statements and explanations related to the five primary research standpoints investigated in this research. The qualitative data were derived from open-ended questionnaire responses and brief verbal interviews. The interviews were conducted to clarify and confirm respondents' questionnaire answers within approximately 30 minutes and were documented through handwritten notes taken during the interviews.

The responses were selected, simplified, coded, and grouped by three coders using the five research standpoints as the analytical framework while remaining open to emerging themes identified from the data. Differences in coding interpretation were discussed among the coders and resolved through consensus-based discussions to improve analytical consistency. The conclusions drawn from the analysis were continuously verified through repeated examination of the data and peer debriefing, involving discussions and cross-checking among the research team members, to minimize interpretive bias and strengthen the credibility of the findings. Meanwhile, representative quotations were selected for their relevance to the identified themes and for their ability to reflect common experiences and challenges reported by respondents.

### *Integration of Quantitative and Qualitative Data*

The integration of quantitative and qualitative data was conducted because this research used an embedded design. The integration process involved comparing and connecting quantitative and qualitative data across the five standpoints investigated in this research: the basis and duration of the subject, teachers' perceptions and understanding, planning and

implementation of the learning, assessment of the learning, and its impacts. In particular, qualitative evidence was used to provide contextual explanations for the patterns identified in the quantitative data. This integration enabled a more comprehensive understanding of the implementation of the *Merdeka* Curriculum in seventh-grade Natural Sciences in Pontianak City.

## RESULTS AND DISCUSSION

### Basis and Duration of Natural Sciences Subject Implementation in the *Merdeka* Curriculum

#### *Distribution of Curriculum Frameworks Implemented*

The *Merdeka* Curriculum represents a systemic change to Indonesia's education system following the COVID-19 pandemic, aiming to address nationwide learning loss. This is supported by a nationwide statistical analysis conducted by Cerelia et al. (2021), who show that there are many disparities in Indonesia during distance learning, ultimately leading to learning loss, especially in provinces located in frontier, outermost, and disadvantaged areas with less-than-optimal internet access. Parahita et al. (2023) found that Indonesian students from the Zillennial generation experienced learning loss consciously during online learning compared to their experience in face-to-face learning before the COVID-19 pandemic. Therefore, the *Merdeka* Curriculum was developed with specific characteristics that have the potential to overcome and anticipate learning loss, such as a focus on essential topics (Permatasari et al., 2025; N. E. Wardani et al., 2025), innovative learning processes centered on students (Fauziah et al., 2023; Permanasari et al., 2024) and technology-based (Astuti et al., 2024; Saa, 2024), as well as character building (Suharni et al., 2025; Tapung, 2025). However, curriculum transition is not easy to implement, especially for teachers, who are the implementers in the field.

Before the COVID-19 pandemic, Indonesia used the 2013 Curriculum. As a replacement for the Education Unit Level Curriculum, which was considered to lack emphasis on character, the 2013 Curriculum was designed to create a creative, innovative, critical, and character-driven society (Afriadi et al., 2024; Rahmah et al., 2024). However, the COVID-19 pandemic, which has forced remote learning to prevent virus transmission, has forced the Indonesian education system to switch to the Emergency Curriculum immediately. The Emergency Curriculum simplified the 2013 Curriculum, aiming to reduce the burden on teachers, students, and parents by focusing on the essential competencies that are prerequisites for the next level of education (N. E. Wardani et al., 2023). After the COVID-19 pandemic subsided and face-to-face learning resumed, the *Merdeka* Curriculum was introduced to address challenges in Indonesian education, emphasizing flexibility in technology-based learning, mastery of essential concepts, and character development to produce competent graduates.

At the beginning of the implementation of the *Merdeka* Curriculum, which was officially launched in the 2022/2023 academic year, educational units were given the freedom to choose one of the three curriculum frameworks applicable in Indonesia, namely the 2013 Curriculum, the Emergency Curriculum, and the *Merdeka* Curriculum (Chandra et al., 2025). This was also the case in junior high schools in Pontianak City (Figure 3). Based on 2023 data, 28 schools in Pontianak have implemented the *Merdeka* Curriculum, while the remaining schools continue to implement the 2013 Curriculum and the Emergency Curriculum. However, data from 2025 shows that all schools have implemented the *Merdeka* Curriculum. This trend indicates a gradual consolidation of curriculum frameworks implementation across junior high schools in Pontianak City over time. Nevertheless, this particular change should be interpreted within the broader context of national curriculum transition policies rather than solely as an indicator of school- or teacher-level initiative.

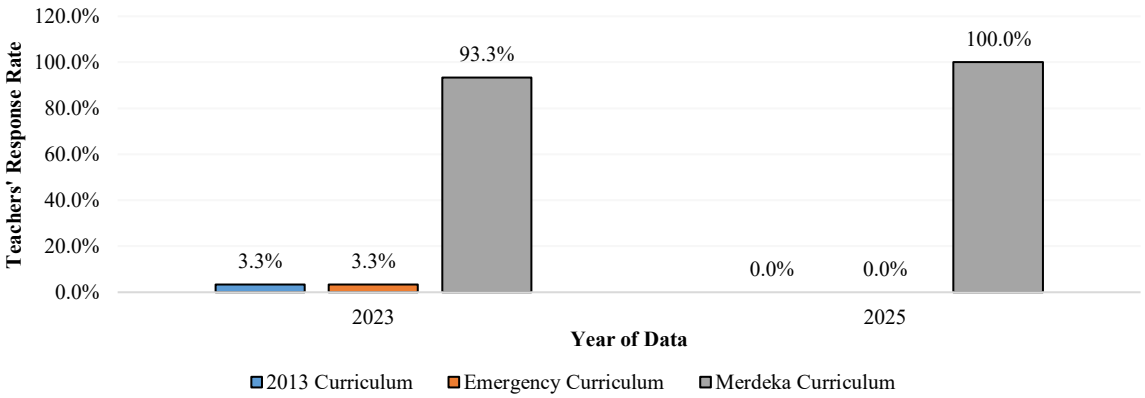



**Figure 3**. Distribution of curriculum frameworks implemented in the seventh-grade Natural Sciences learning in 2023 and 2025

The observed increase in the implementation of the *Merdeka* Curriculum is consistent by the curriculum transition provisions contained in the Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia (*Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia* [Kemendikbudristek RI], 2024) Number 12 of 2024 concerning the Curriculum for Early Childhood Education, Primary Education, and Secondary Education, which states that all educational units at these three levels must implement the *Merdeka* Curriculum by the 2026/2027 academic year at the latest. The complete adoption of the *Merdeka* Curriculum observed in 2025 may reflect the continuing national policy translation and institutional adjustment process toward the mandated curriculum framework. Therefore, the curriculum reform towards the *Merdeka* Curriculum has achieved sufficient stability to encourage schools and teachers to adapt to the curriculum framework. In other words, the particular findings regarding the curriculum frameworks implemented in 2023 and 2025 should not be interpreted as evidence that curriculum implementation challenges have been fully resolved, but rather as an indication that institutional-level regulation adoption has become increasingly standardized.

***Duration of Natural Sciences Lesson Hours per Week***

The implementation of learning in a curriculum, including the *Merdeka* Curriculum, cannot be separated from the allocation of lesson hours each week. Lesson hours are the time allocated for the teaching and learning process at school for a subject (Ruiz-Gallardo et al., 2016). The number of minutes allocated per lesson hour varies between education levels, with one lesson hour at the junior high school level equal to 40 minutes. In this research, Natural Sciences teachers in junior high schools in Pontianak City taught for 3–5 lesson hours per week in both 2023 and 2025 (Figure 4).

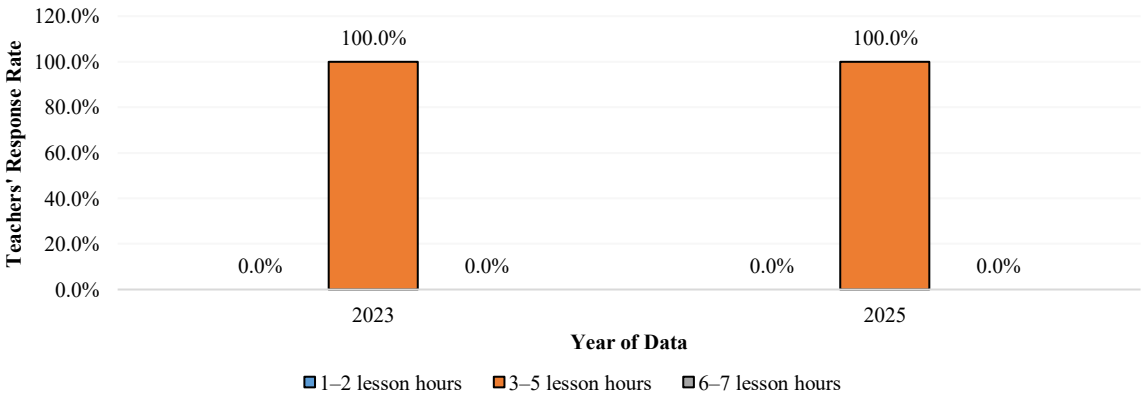



**Figure 4**. Duration of Natural Sciences lesson hours per week in 2023 and 2025

The moderate lesson hours are beneficial for students, as they help maintain effective learning without cognitive overload. The duration of these lessons will be divided between intracurricular activities (80%) and the Pancasila Student Profile Strengthening Project (*Proyek Penguatan Profil Pelajar Pancasila*, hereinafter referred to as P5) (20%).

However, it should be noted that the term P5 is no longer used in 2025 and has been replaced by cocurricular activities. Nevertheless, Natural Sciences teachers in junior high schools in Pontianak City still use the term P5. As a replacement for the P5 role, cocurricular activities in the *Merdeka* Curriculum refer to a variety of learning activities carried out to strengthen, deepen, and/or enrich intracurricular activities aimed at developing student competencies. The distribution of lesson hours between intracurricular and cocurricular activities is in accordance with Regulation Number 12 of 2024 of the Kemendikbudristek RI (2024), which was later amended by Regulation Number 13 of 2025 of the Ministry of Elementary and Secondary Education of the Republic of Indonesia (*Kementerian Pendidikan Dasar dan Menengah Republik Indonesia* [Kemendikdasmen RI], 2025b). This regulation states that the Natural Sciences lesson hours in seventh-grade in one year are 180, consisting of 144 for intracurricular activities and 36 for cocurricular activities.

***Distribution of Natural Sciences Lesson Hours in Each Semester***

The distribution of Natural Sciences lesson hours throughout the year, by semester, at junior high schools in Pontianak City varies by teacher (Figure 5). The data obtained shows that the majority of teachers distributed Natural Sciences lesson hours evenly in 2023, with an increase in 2025. This is assumed to be caused by teachers having adapted well to the *Merdeka* Curriculum framework, while ensuring that learning opportunities throughout the school year are distributed fairly without burdening students in specific semesters. Permana et al. (2025) argue that an even distribution of lesson hours will support the efficient use of teacher and classroom resources to overcome the complexity of implementing the *Merdeka* Curriculum in schools. Apart from evenly distributed lesson hours, data from 2023 show that some teachers allocate more Natural Sciences lesson hours in the odd semester. This much smaller proportion also increased in 2025. Furthermore, data from 2023 shows that a smaller proportion of teachers allocate more Natural Sciences lesson hours in the even semester and adjust them to the number of effective weeks. However, data from 2025 reveal that no teachers apply these two patterns of lesson hours allocation. This is supported by the characteristics of the *Merdeka* Curriculum, which gives teachers the freedom to allocate lesson hours as needed, provided the total number of lesson hours per year is met (Ndari et al., 2023).

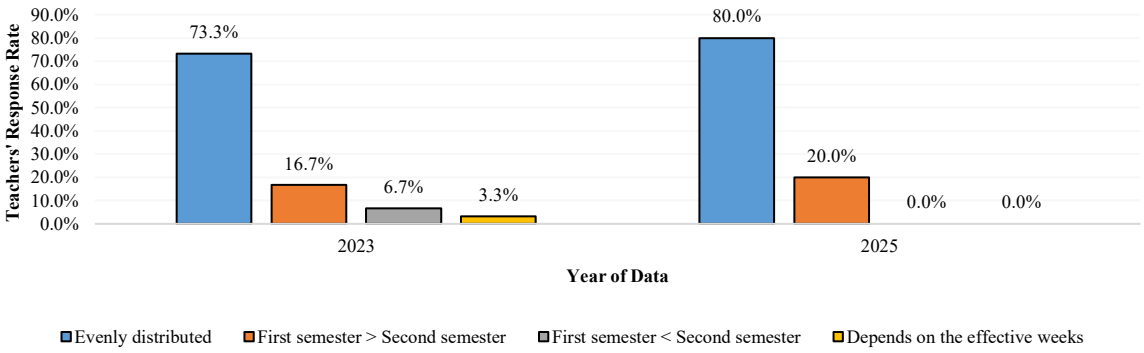



**Figure 5**. Distribution of Natural Sciences lesson hours in each semester in 2023 and 2025

Based on the interviews, it was revealed that teachers who distribute lesson hours evenly find it easier to determine the learning duration for each topic in each semester. For example, if there are six topics in one academic year, they will be divided into three topics for the odd semester and three for the even semester. Teachers who chose an uneven distribution of lesson hours (more in the odd semester than in the even semester and vice versa) explained that this choice was based on the agendas that would take place in the odd or even semester, such as

religious holidays and the implementation of the Minimum Competency Assessment (now integrated as part of the National Assessment) for ninth-grade students. Meanwhile, teachers who chose to divide lesson hours based on effective weeks explained that learning in semesters with more effective weeks could encourage the achievement of more learning objectives, while learning in semesters with fewer effective weeks remained optimal because there were fewer learning objectives to be achieved. Findings related to the basis for implementing Natural Sciences learning indicate that every junior high school in Pontianak City has now implemented the *Merdeka* Curriculum. This implementation is certainly not limited to administrative documents but is also reflected in the patterns of learning planning and management. Furthermore, the analysis of the Natural Sciences lesson hours and their distribution across semesters underscores the nature of the *Merdeka* Curriculum, which gives teachers the freedom to design learning according to their needs. This is supported by Syofyan et al. (2024) and Ningsih et al. (2025), who indicate that the philosophy of the *Merdeka* Curriculum entrusts teachers with the capability to manage and implement learning that can be adapted to the needs of teachers and students in supporting the achievement of predetermined learning outcomes. Therefore, the *Merdeka* Curriculum centers teachers in instructional decision-making.

## Teachers' Perceptions and Understanding of the *Merdeka* Curriculum in Natural Sciences Learning

### *Primary Essences of the* Merdeka *Curriculum Based on Teachers' Perceptions*

In general, Natural Sciences teachers in junior high schools in Pontianak City interpret the *Merdeka* Curriculum as a flexible framework that empowers teachers to design student-centered learning relevant to current needs, while emphasizing Pancasila values through the Pancasila Student Profile (*Profil Pelajar Pancasila*, hereinafter abbreviated as P3). Some of the teachers' responses in the 2025 data that illustrate this are "*The* Merdeka *Curriculum gives teachers the freedom to design learning that is tailored to the needs of students (differentiation) and is more contextual*" (T7, female, 1–5 years of teaching experience) and "*The essence of the* Merdeka *Curriculum in junior high school Natural Sciences learning is to produce students who not only know concepts but are also able to think scientifically, solve real problems, and have the character described in P3*" (T6, female, 1–5 years of teaching experience). Furthermore, teachers stated that the *Merdeka* Curriculum can develop student competencies, as illustrated by the response, "*In my opinion, to develop student competencies through in-depth understanding and scientific process skills by focusing on essential topics, project-based learning, and strengthening P3*" (T3, female, 11–15 years of teaching experience; 2025 phase). This response aligns with the research by Ningsih et al. (2025), which found that the learning outcomes of the *Merdeka* Curriculum in exact subjects include not only essential topics to be learned but also various scientific process skills that students must master. Science process skills refer to the mental and physical activities students perform to collect, organize, and process information scientifically (Gizaw & Sota, 2023; Mulyeni et al., 2019). Therefore, it can be inferred that Natural Sciences teachers in junior high schools in Pontianak City have been able to interpret and understand the *Merdeka* Curriculum in accordance with its intended philosophy.

Figure 6 presents a summary of teachers' perceptions of the main essences of the *Merdeka* Curriculum obtained from the questionnaire distributed in 2025, considering the development of teachers' understanding of the *Merdeka* Curriculum over time. However, it should be noted that as of 2025, in accordance with Regulation Number 10 of 2025 of the Kemendikdasmen RI (2025a) concerning Graduate Competency Standards in Early Childhood Education, Primary Education, and Secondary Education, the term P3 is no longer used and has been replaced by the Graduate Profile Dimensions, which include eight dimensions: faith and devotion to God Almighty, citizenship, critical thinking, creativity, collaboration,

independence, health, and communication. However, as with the term P5, the term P3 is still used by Natural Sciences teachers in junior high schools in Pontianak City, indicating that the curriculum changes process has not been entirely smooth and that old practices are still carried over in daily implementation. These findings also indicate that further training and support are needed so that teachers in Pontianak City can align the terms, concepts, and orientation of graduate competencies with the requirements of the latest *Merdeka* Curriculum, which has been in effect since 2025.

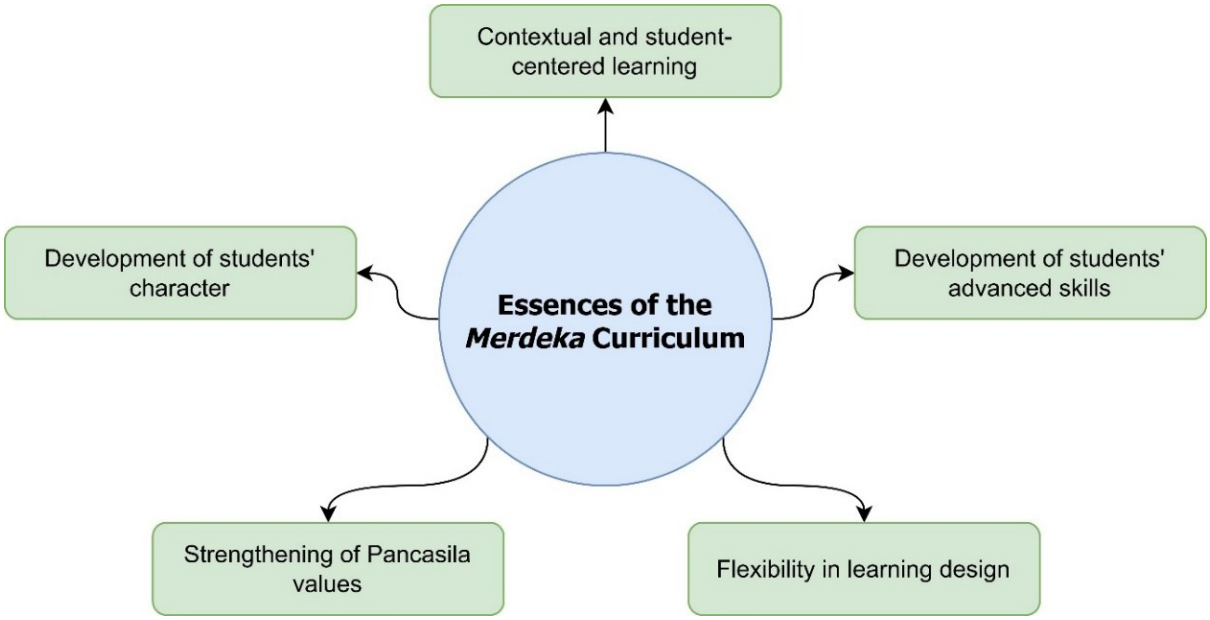



**Figure 6**. Teachers' perceptions on the primary essences of the *Merdeka* Curriculum in Natural Sciences

***Sufficiency in Training and Mentoring Related to the* Merdeka *Curriculum***

Regarding perceptions and understanding of the *Merdeka* Curriculum, it is evident that teachers must be equipped through training and mentoring to better implement it. Data from 2025 indicate that 46.7% (almost half) of Natural Sciences teachers in junior high schools in Pontianak City feel they have not received sufficient training and mentoring related to the *Merdeka* Curriculum. Data collection on the adequacy of training and mentoring was conducted only in 2025, as not all schools had implemented the *Merdeka* Curriculum in 2023. The proportion of teachers who had not received training and mentoring on the *Merdeka* Curriculum was worth noting because it could negatively affect their readiness to implement it. This finding is also reflected in the previous results, which reveal that Natural Sciences teachers still use the terms P3 and P5, which have now been replaced by Graduate Profile Dimensions and cocurricular activities in accordance with the characteristics of the *Merdeka* Curriculum in 2025. This phenomenon suggests the presence of a policy language drift or implementation lag, in which changes to certain terms in the latest *Merdeka* Curriculum regulations have not yet been fully incorporated into teachers' daily practices. The continued use of previous terminology (P3 and P5) may reflect the rapid evolution of the *Merdeka* Curriculum regulations and the limited continuity of teacher training and mentoring during the transition process.

The proportion of teachers who reported insufficient training and mentoring related to the *Merdeka* Curriculum suggests that inadequate professional support may contribute to difficulties in adapting to updated curriculum concepts and terminologies. To date, several research have shown that many teachers are not yet ready to implement the *Merdeka* Curriculum holistically, such as Khery et al. (2024) and Delita et al. (2025). Rosanawati et al. (2025) concluded that, in addition to limitations in pedagogical and technological competencies, inadequate infrastructure, and difficulties in applying innovative learning

models, suboptimal teacher training and mentoring are among the main reasons for the gap in the implementation of the *Merdeka* Curriculum. Furthermore, research by Wildan et al. (2026) reveals that teachers with more experience in implementing structured curricula (such as the Competency-based Curriculum introduced in 2004 and the Education Unit Level Curriculum launched in 2006) have struggled to transition to the *Merdeka* Curriculum, a far more flexible curriculum framework. These findings indicate that intensive training and mentoring for the Natural Sciences teachers are needed to improve their understanding and skills, preparing them to implement the *Merdeka* Curriculum.

***Substantial Changes in Curriculum Transition Based on Teacher's Perceptions***

Natural Sciences teachers in junior high schools in Pontianak City stated that several substantial changes were felt during the curriculum transition, namely flexibility in learning design, student-centered learning, learning assessments beyond exams, and the existence of P5. This is supported by the responses expressed by several teachers in the data collected in 2025, such as "*Flexibility for teachers to innovate in learning methods*" (T3, female, 11–15 years of teaching experience), "*Teachers as facilitators because learning is student-centered*" (T2, female, 21–30 years of teaching experience), "*Assessment does not only focus on exams, but emphasizes portfolios, projects, and work samples*" (T4, female, 6–10 years of teaching experience), "*Formative assessments that emphasize the process and the existence of diagnostic assessments*" (T7, female, 1–5 years of teaching experience), and "*The most significant difference is that P5 is something new that opens students' minds to real-life situations, not just theory in the classroom*" (T6, female, 1–5 years of teaching experience). These changes certainly reflect the characteristics of the *Merdeka* Curriculum, which emphasizes teachers' freedom to create learning experiences that develop students' competencies and potential in a profound and relevant manner. This is supported by Saa (2024), who states that the *Merdeka* Curriculum underlines the importance of contextual learning and supports students in maximizing their potential by implementing learning that takes into account their interests, talents, and needs.

**Planning and Implementation of Natural Sciences Learning in the *Merdeka* Curriculum**

***Planning of Natural Sciences Learning***

The main features of the *Merdeka* Curriculum, which give teachers freedom to design learning according to students' needs, have certainly led to changes in the design of Natural Sciences learning. One of the most notable changes between the learning plan in the 2013 Curriculum and the *Merdeka* Curriculum is the use of syllabi and learning outcomes as the basis for developing the topics to be taught to students. This is supported by one of the teachers who responded, "*Among the changes are that competency standards have been changed to essential competencies and learning objectives*" (T5, female, 21–30 years of teaching experience; 2025 phase). Broadly speaking, the syllabi in the 2013 Curriculum covers core competencies, basic competencies, indicators, learning contents and activities, time allocation, assessment systems, and learning resources (Saputri et al., 2025), while the learning outcomes in the *Merdeka* Curriculum only contain essential topics per phase of student development (Foundation Phase for early childhood education [Robingatin et al., 2025], A–C Phases for primary education [H. K. Wardani et al., 2023], and D–F Phases for secondary education [Sofiani et al., 2025]) that can be taught according to needs. Although the national government published both, the learning plan in the 2013 Curriculum emphasized strict completion of the basic competencies outlined in the syllabi, resulting in a large number of uniform topics nationwide. Meanwhile, the learning outcomes in the *Merdeka* Curriculum are designed to reduce the number of topics in the 2013 Curriculum syllabi and provide greater flexibility in implementation. In addition, learning outcomes in the *Merdeka* Curriculum, particularly in exact subjects such as the Natural Sciences, include various scientific process skills that students must master as they study the essential topics. Furthermore, the *Merdeka* Curriculum

also includes P3 to develop students' character.

Changes to the planning of Natural Sciences learning in the *Merdeka* Curriculum are not based solely on the syllabi and learning outcomes, but also on the documents that teachers must develop. The change in question is the change from a document in the form of lesson implementation plans in the 2013 Curriculum to teaching modules in the *Merdeka* Curriculum, with one of the teachers' responses being, for example, "*The main change is the use of teaching modules to replace lesson implementation plans and the arrangement of learning objectives from learning outcomes*" (T3, female, 11–15 years of teaching experience; 2025 phase). Although both are crucial documents that serve as guidelines for teachers in carrying out learning activities, lesson implementation plans and teaching modules differ in their components. The lesson implementation plan includes the school's identity, subject, class, semester, time allocation, core competencies, basic competencies, competency achievement indicators, learning contents, learning activities, assessment, as well as learning media, tools, materials, and resources (Riana et al., 2016). Meanwhile, teaching modules include more components, as shown in Table 5 (Wahyuni & Faturrahman, 2024). The components in teaching modules indicate more comprehensive learning planning, ensuring that learning activities can be carried out correctly and minimizing the risk of obstacles. In addition, the *Merdeka* Curriculum emphasizes the formulation of learning objectives based on predetermined learning outcomes. Sofiani et al. (2025) wrote that the learning outcomes in the *Merdeka* Curriculum contain essential topics that are still general in nature, so they need to be broken down into learning objectives that are achieved one by one until the end of the phase, to then be compiled into a learning objectives flow.

**Table 5**. Components of *Merdeka* Curriculum's teaching modules

| No. | Section | Component |
|---|---|---|
| 1 | General information | Module author's identity |
| | | Initial competencies |
| | | P3 |
| | | Facilities and infrastructure |
| | | Target students |
| | | Learning model |
| 2 | Main components | Learning objectives |
| | | Assessment |
| | | Meaningful understanding |
| | | Trigger questions |
| | | Learning activities |
| | | Teachers' and students' reflections |
| 3 | Appendices | Student worksheets |
| | | Enrichment and remedial materials |
| | | Reading materials for teachers and students |
| | | Glossary |
| | | Bibliography |

### *Learning Models Utilized by Natural Sciences Teachers*

In supporting student-centered learning in accordance with the requirements of the *Merdeka* Curriculum, it was revealed that Natural Sciences teachers in junior high schools in Pontianak City have used specific learning models that can support the development of students' potential. A learning model is a conceptual framework that describes systematic procedures for teachers to carry out well-structured, well-organized learning activities (Marlina et al., 2025). The data obtained shows that the teachers use various learning models (Figure 7), with a shift in trends between the two years compared. In 2023, it was found that teachers used five main learning models, namely contextual teaching and learning, cooperative learning, discovery learning, problem-based learning (PBL), and project-based learning (PjBL).

Meanwhile, data from 2025 shows the addition of one learning model, namely inquiry learning. Furthermore, the 2025 data shows a remarkable distribution of learning models, indicating greater learning variation than in 2023. The changing trends in the learning models used by Natural Sciences teachers in junior high schools in Pontianak City may be due to greater freedom in designing learning that is appropriate to the context of the students, the encouragement to be creative and innovative facilitators, and participation in various training and mentoring related to the *Merdeka* Curriculum, which changes the learning paradigm.

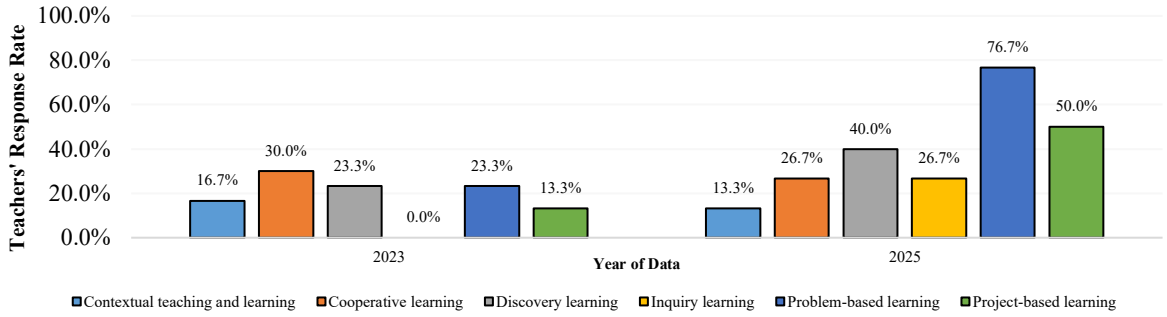



**Figure 7**. Distribution of learning models utilized by Natural Sciences teachers in 2023 and 2025

The six learning models used by Natural Sciences teachers in junior high schools in Pontianak City have been proven by various research to improve student learning outcomes, as demonstrated by Juniwati et al. (2020), Tadesse et al. (2024), Indriani et al. (2025), Rosfiani et al. (2020), Putri & Suwono (2023), and Crawford et al. (2024), respectively. The data obtained shows that the PBL and PjBL learning models are the most widely used in 2025. In addition to improving learning outcomes, the PBL learning model has been proven to enhance many types of skills, such as critical thinking skills (Arifin et al., 2020), health literacy (Suwono et al., 2023), interdisciplinary thinking skills (Putri & Suwono, 2023), metacognitive skills (Yusuf et al., 2025), problem-solving skills (Valdez & Bungihan, 2019), and science process skills (Kasuga et al., 2022). Similar to PBL, the PjBL learning model is known to have the ability to improve various skills, such as creative thinking skills (Atmojo et al., 2025), critical thinking skills (Jirana et al., 2020), energy literacy (Karpudewan et al., 2016), information and communication technology literacy (Eliana et al., 2016), science process skills (Nurulwati et al., 2021), and scientific writing skills (Septriana et al., 2025). The use of innovative learning models indicates that teachers understand the need for learning that supports student development, not only in understanding concepts but also in mastering 21$^{st}$-century skills.

### *Learning Methods Utilized by Natural Sciences Teachers*

Concerning the implementation of learning activities, Natural Sciences teachers in junior high schools in Pontianak City have used various learning methods. Learning methods refer to the ways and techniques teachers use to deliver learning content to achieve learning objectives (Sibarani, 2021). The questionnaire revealed that nine teaching methods were used: discussion, presentation, observation, lecture, practicum, project, question-and-answer, assignment, and demonstration. The choice of learning method must be tailored to the topic being taught to students (Titin et al., 2025). This reason is supported by one of the teachers who responded, "*Discussion, projects, lectures, depend on the topic*" (T24, female, 16–20 years of teaching experience; 2023 phase). The diversity of teaching methods used indicates that the teachers have adapted to students' varying characteristics, backgrounds, levels of understanding, and mastery of the learning content.

### *Collaboration Among Natural Sciences Teachers and Other Subjects*

The implementation of the *Merdeka* Curriculum is inseparable from teacher collaboration. The *Merdeka* Curriculum emphasizes collaboration among teachers as an essential quality to foster dynamic and responsive learning processes that prioritize the

diversity of students' needs (Kusumawati et al., 2025). Therefore, teacher collaboration is also inseparable from the implementation of Natural Sciences learning in junior high schools in Pontianak City (Figure 8). The results obtained show that collaboration is carried out with fellow Natural Sciences teachers and with teachers of other subjects. However, the proportion of collaboration that occurs is not yet optimal. Data from 2023 indicate that collaboration, both between Natural Sciences teachers and with teachers of other subjects, remains limited, with the proportion of teachers collaborating falling short of half of the research sample. However, data from 2025 shows a drastic increase, although the proportion of Natural Sciences teachers collaborating with teachers of other subjects remains lower than the proportion collaborating with Natural Sciences teachers.

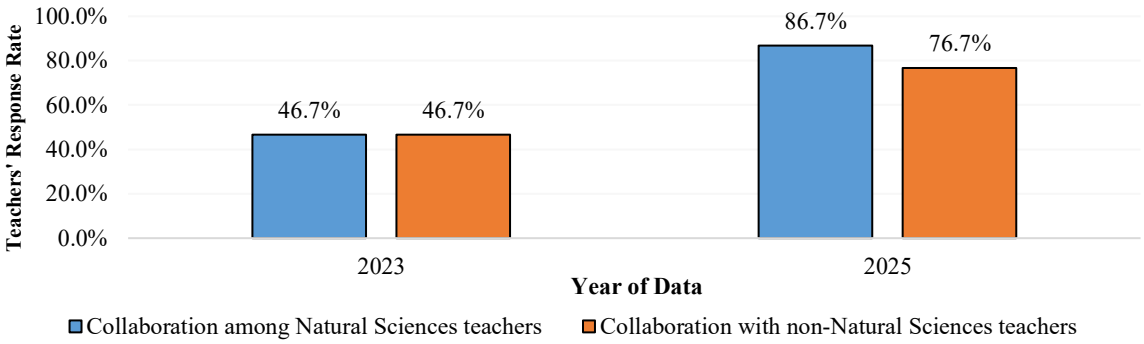



**Figure 8**. Collaboration patterns among Natural Sciences teachers and with teachers of other subjects in 2023 and 2025

The increase in collaboration among Natural Sciences teachers may be due to greater opportunities and shared areas of expertise, both of which are undoubtedly beneficial to the teachers. Collaboration among Natural Sciences teachers has been shown to affect classroom learning positively (Lepareur & Grangeat, 2018; Pečiuliauskienė et al., 2023). The collaboration includes the creation of learning instruments (such as teaching modules and assessments), the formulation of learning objectives and learning objectives flows, discussions on the best learning models and methods for specific topics, and discussions on the continuity of topics taught across classes or levels. Moreover, some teachers imply that collaboration is not limited to the school environment but also extends to the Subject Teacher Forum (*Musyawarah Guru Mata Pelajaran*, hereinafter known as MGMP). The MGMP organization facilitates specific subject teachers in communicating and discussing the application and implementation of learning activities and problem-solving strategies during the learning process (Daryanto et al., 2020; Edwar et al., 2020; Winingsih et al., 2019). However, a small number of Natural Sciences teachers have not yet collaborated with their peers. The questionnaire revealed that the obstacles encountered included limited time for discussion, a lack of colleagues to collaborate with (only one Natural Sciences teacher at the school), and limited experience in implementing collaborative learning.

Meanwhile, the increase in collaboration between Natural Sciences teachers and teachers of other subjects was primarily due to the existence of P5. The data obtained revealed that the implementation of P5 involved teachers of specific subjects, such as Crafts, Social Sciences, and Indonesian Language, to address the planned P5 themes. In addition, it was found that collaboration outside of P5 involved Guidance Counseling teachers discussing concerns regarding student attitudes and behavior. This certainly supports collaborative learning that benefits many parties. Collaboration among teachers of different subjects has a positive impact on the learning process, learning outcomes, and students' acquisition of various skills (de Jong et al., 2019; Mora-Ruano et al., 2019; Sund & Gericke, 2020; Xie et al., 2023). However, as with similar results in collaboration among Natural Sciences teachers, a small number of teachers have not implemented interdisciplinary collaboration. The data obtained reveals that

the main reason for the lack of collaboration is time constraints, which make it challenging to hold discussions and collaborate at school. This is unfortunate, considering that today's learning prioritizes multidisciplinarity to prepare students with adequate knowledge and skills (Chaovanapricha & Chaturongakul, 2020).

Findings on changes in learning planning and implementation reveal that Natural Sciences teachers in junior high schools in Pontianak City have been able to adjust their teaching to better focus on students by considering their learning needs and available infrastructure. This is particularly evident in the use of learning models and methods that can support students' cognitive, affective, and psychomotor development. In addition, the collaboration among the teachers indicates that a space for jointly improving school learning quality has begun to emerge. However, implementing collaboration in the *Merdeka* Curriculum remains a persistent challenge to be optimized. This is supported by the statement of de Jong et al. (2019) that, although teacher collaboration plays an important role in the quality of the profession, its implementation is not without various obstacles that make it challenging. Therefore, the proportion of teachers who have not yet engaged in collaboration must be addressed, as teacher collaboration is an essential component of teacher professionalism (Wijarwadi et al., 2025).

## Assessment of Natural Sciences Learning in the *Merdeka* Curriculum

### *Roles of Assessment in the Merdeka Curriculum*

The implementation of Natural Sciences learning in the *Merdeka* Curriculum will indeed not be separated from assessment. As an integral and pivotal part of learning (Liontou, 2021; Montenegro-Rueda et al., 2021), assessment aims to gather information about each student's level of comprehension of the taught topic. Furthermore, Schellekens et al. (2021) concluded that assessment plays an important role because it influences what students consider important, the quality and extent of their participation and understanding of learning, and how they apply their understanding to future learning. Natural Sciences teachers in junior high schools in Pontianak City perceive that assessment in the *Merdeka* Curriculum has undergone critical changes compared to that in the 2013 Curriculum. Some examples of responses obtained from the data collected in 2025 are "*Assessment is more comprehensive, authentic, focused on the process, and describes the abilities of each student*" (T2, female, 21–30 years of teaching experience) and "*In the* Merdeka *Curriculum, assessment does not solely focus on final scores, but emphasizes the learning process through authentic assessments such as projects, portfolios, and student performance*" (T4, female, 6–10 years of teaching experience), illustrating that Natural Sciences teachers in junior high schools in Pontianak City have understood the nature of the *Merdeka* Curriculum assessment, which emphasizes comprehensive and authentic assessment and focuses on the process, compared to the 2013 Curriculum, which only assesses final results. This finding aligns with Setyawarno et al. (2025), who suggest that the *Merdeka* Curriculum paradigm requires continuous assessment from the beginning to the end of learning to measure the learning process and student achievement holistically. Therefore, the understanding of Natural Sciences teachers in junior high schools in Pontianak City reflects a high level of professionalism and pedagogical competence, supporting the optimization of learning activities through balanced continuous assessment.

### *Types of Assessment in the Merdeka Curriculum*

The implementation of continuous assessment in the *Merdeka* Curriculum is supported by its structure, which divides assessment into three types: diagnostic, formative, and summative (Table 6). This is supported by the response from one of the teachers: "*The assessments utilize diagnostic, formative, and summative approaches, not only structured academic assessments as in the 2013 Curriculum, but also project-based, authentic assessments, and an emphasis on student independence in real-world contexts*" (T3, female,

11–15 years of teaching experience; 2025 phase). The three types of assessment are not only used to assess the learning outcomes and processes of students, but also to assess the achievement of the P3 dimensions, as supported by the response of one of the teachers: "*The change in assessment in the* Merdeka *Curriculum shifts the focus from final results to a more holistic and continuous process assessment, covering the areas of knowledge, skills, and attitudes, as well as the P3*" (T3, female, 11–15 years of teaching experience; 2025 phase). These findings indicate that Natural Sciences teachers in junior high schools in Pontianak City are aware that assessments in the *Merdeka* Curriculum can support the holistic development of students in accordance with Pancasila values, while providing valuable information for teachers to adjust learning activities to suit students' needs. Levy-Feldman (2025) implies that student assessments must be conducted within authentic sociocultural contexts to respect their cultural backgrounds, experiences, and knowledge, thereby cultivating assessments that play a pivotal role in developing 21$^{st}$-century skills.

**Table 6**. Assessment types in the *Merdeka* Curriculum

| No. | Assessment Type | Description |
|---|---|---|
| 1 | Diagnostic | Utilized for identifying students' readiness and differentiation in learning styles through strengths, weaknesses, initial knowledge and interest, and characteristics of students, whether it is cognitive or non-cognitive, before the learning activities start |
| 2 | Formative | Utilized for giving continuous feedback during the learning process in order to review the development of students and assist the improvement of teacher and students' learning activities |
| 3 | Summative | Utilized for assessing students' degree of comprehension and their achievement of learning objectives, becoming a basis for their quantitative grades |

### *Teachers' Perceptions on Students' Learning Achievements*

The current analysis reviewed how teachers perceive the achievement of students' learning outcomes and activities, recognizing that both are important for describing the perceived role of the *Merdeka* Curriculum in developing students' potential. Within the context of the *Merdeka* Curriculum, learning outcomes and activities are commonly associated with how teachers can design student-centered learning that accommodates the needs of each individual, thereby supporting the development of students' competencies (in the cognitive, affective, and psychomotor domains) and increasing student engagement in learning activities. Therefore, teachers' perceptions of these aspects provide important insights into how the *Merdeka* Curriculum is implemented at the classroom level. The data regarding students' achievement on learning outcomes and activities based on teachers' perceptions and reflections in classroom learning practices showed a positive trend in comparisons for 2023 and 2024 (Table 7).

**Table 7**. Percentages of students' learning achievement based on teachers' perceptions

| No. | Aspect | Year | |
|---|---|---|---|
| | | 2023 | 2024 |
| 1 | Learning outcomes | 60–65% | 65–80% |
| 2 | Learning activities | 60–75% | 80–90% |

Note: The percentages presented are solely from teachers' perceptions rather than from the actual standardized student achievement data

The percentages obtained regarding students' learning outcomes suggest that student-centered learning interventions aligned with the *Merdeka* Curriculum philosophy are perceived to support the achievement of the competencies students must master. This aligns with Tsihouridis (2024), who emphasizes the importance of optimizing the planning and implementation of Natural Sciences learning to improve student learning outcomes across

cognitive, affective, and psychomotor domains. Meanwhile, the percentage regarding learning activities' achievement underscores the teachers' perceptions that the *Merdeka* Curriculum encourages more active student participation in learning activities. The research conducted by Alvina et al. (2025) highlights that student engagement is an essential component of seventh-grade Natural Sciences learning, particularly given the subject's characteristics that require the development of students' science process skills. Ayu et al. (2026) point out that the development of science process skills is interconnected with the enhancement of quantitative literacy. Nowadays, quantitative literacy is a mandatory skill for students, given that Natural Sciences—especially biology—are increasingly quantitative (Milligan & Rohde, 2024; Vittadello & Stumpf, 2022).

The findings related to student learning outcomes and activities in the Natural Sciences subject in junior high schools in Pontianak City are in line with Permatasari et al. (2025), who state that the *Merdeka* Curriculum emphasizes student-centered learning to support contextual and exploratory activities as a solution to overcome the decline in student learning outcomes and activities after the COVID-19 pandemic. The improvement in student learning outcomes and activities can also be attributed to the assessment paradigm in the *Merdeka* Curriculum, which encourages Natural Sciences teachers to provide more targeted feedback to enhance students' learning processes and outcomes. Overall, the increase in the achievement of learning outcomes and activities is certainly a positive indicator that the implementation of the *Merdeka* Curriculum can improve the quality and effectiveness of Natural Sciences learning by providing space for adaptation and creativity tailored to the needs of teachers and students. Thus, the essential topics contained in the *Merdeka* Curriculum learning outcomes can be achieved by enhancing their relevance and contextualization to real classroom needs.

## Impacts of the *Merdeka* Curriculum on Natural Sciences Learning

### *Positive Impacts of the Merdeka Curriculum*

The implementation of the *Merdeka* Curriculum cannot be separated from teachers' assessments of the positive impacts they experience as the parties implementing the regulations in the field. The percentage of Natural Sciences teachers in junior high schools in Pontianak City who report positive impacts from the *Merdeka* Curriculum is presented in Figure 9.

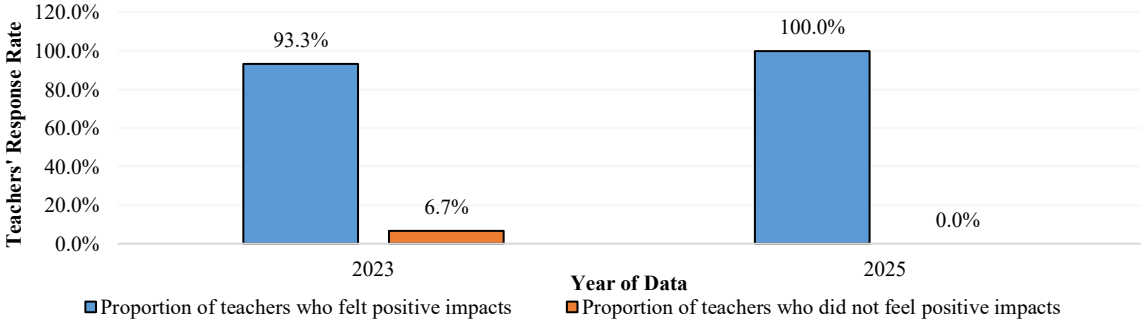



**Figure 9**. Reports on impacts of the *Merdeka* Curriculum implementation in 2023 and 2025

Data from 2023 shows that a small number of teachers do not feel the positive impacts of the *Merdeka* Curriculum. This is due to the teachers have only experienced the implementation of the *Merdeka* Curriculum for a relatively short time, so they are not yet able to assess the impacts of the curriculum's implementation, as seen from the teachers' responses in the 2023 data: "*Because it has not been felt*" (T1, male, 11–15 years of teaching experience) and "*Because the* Merdeka *Curriculum was only implemented this year, so we have not felt its positive impacts*" (T15, male, 6–10 years of teaching experience). Meanwhile, teachers who felt the positive impacts noted that the *Merdeka* Curriculum encourages student-centered learning, leading to increased student participation and improved learning outcomes. This is supported by several examples of responses given by teachers in 2023, namely "*Students find*

*it easier to understand the lessons, are better able to think critically and relate the topic to everyday life, and are more confident in expressing ideas or concepts related to the topic*" (T17, male, 1–5 years of teaching experience), "*Students are given the freedom to express their learning according to their interests*" (T12, female, 1–5 years of teaching experience), and "*Because the* Merdeka *Curriculum focuses more on the learning process for students, supporting them to be more active and independent*" (T29, female, 21–30 years of teaching experience).

Meanwhile, teachers also stated that the *Merdeka* Curriculum gives them the freedom to determine the topics to teach students, thereby helping reduce the cognitive load they must carry. One teacher's response that reflects this impact is, "*The topics are shorter, only essential topics*" (T30, female, 1–5 years of teaching experience; 2023 phase). Reducing cognitive load can encourage teachers to teach essential topics in greater depth. Furthermore, Natural Sciences teachers at junior high schools in Pontianak City stated that the implementation of the *Merdeka* Curriculum not only encourages teachers to focus on achieving cognitive acquisition but also on acquiring various skills and positive attitudes during learning. The existence of P5 is expected to support students in mastering the dimensions of P3, as reflected in one of the teachers' responses: "*After completing their learning, students become more skilled, especially with P5, which makes them more creative and innovative*" (T20, male, 1–5 years of teaching experience; 2023 phase). The principle of P5 implementation is based on a project-based approach to acquiring knowledge and strengthening character, grounded in Pancasila values, within their surrounding environment (Rachman et al., 2024). Similar positive impacts were observed in the 2025 data, with all Natural Sciences teachers in junior high schools in Pontianak agreeing that the implementation of the *Merdeka* Curriculum is beneficial for the learning process.

### *Obstacles Faced in Implementing the* Merdeka *Curriculum*

Although the proportion of those who feel the positive impact of the *Merdeka* Curriculum is very high, it cannot be denied that Natural Sciences teachers in junior high schools in Pontianak City have experienced obstacles in its implementation. This is in line with the statements of H. K. Wardani et al. (2023) and Wildan et al. (2026), which conclude that curriculum transitions in Indonesia tend to pose great challenges for teachers, as they necessitate continuous adaptation of instructional methodologies in order to conform to constantly changing frameworks. Furthermore, modern education emphasizes that teachers must be able to create learning systems that support students' development in a dynamic and integrated manner in order to build strong learning communities, foster growth across various learning domains, and provide frameworks for fostering productive and academically meaningful relationships and progress (Darling-Hammond et al., 2020). Figure 10 reports the proportion of teachers who experienced obstacles in 2023 and 2025. In 2023, almost all teachers experienced obstacles. However, the 2025 data shows an improvement, as indicated by a decrease in the proportion of teachers who experienced obstacles in implementing the *Merdeka* Curriculum. This pattern suggests that teachers gradually adapted to the *Merdeka* Curriculum. Nonetheless, the findings demonstrate that several challenges persisted throughout the implementation process.

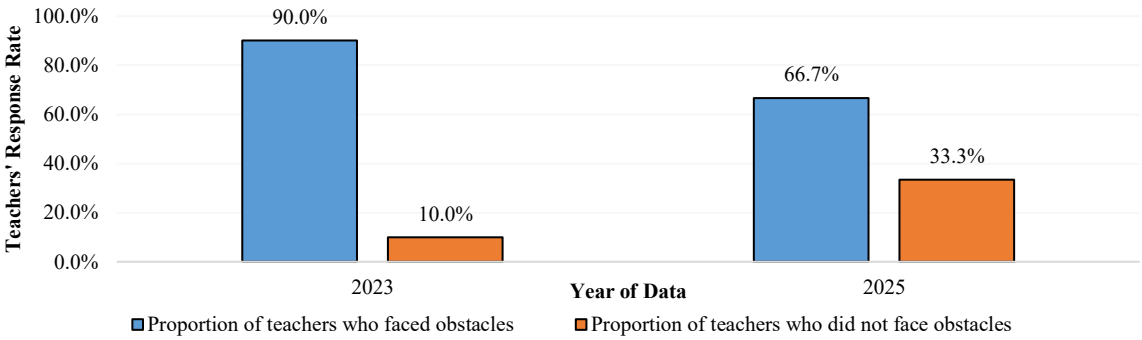



**Figure 10**. Reports on perceived obstacles during the implementation of the *Merdeka* Curriculum in 2023 and 2025

The obstacles identified in this research were not limited to technical issues but also reflected broader challenges such as curriculum understanding, regulatory adaptation, pedagogy, professional support, and resources. Therefore, the obstacles encountered by Natural Sciences teachers, based on the 2023 and 2025 data, were categorized into several major dimensions, as presented in Table 8. This categorization helps explain that the implementation of the *Merdeka* Curriculum involves interconnected challenges at both the instructional and institutional levels, rather than isolated classroom-level difficulties. These findings align with Rosanawati et al. (2025), who argue that the primary reasons for the gap in implementing the *Merdeka* Curriculum include suboptimal teacher training and mentoring, teachers' unpreparedness, limitations in pedagogical and technological competencies, inadequate infrastructure, and difficulties in applying innovative learning models. The findings imply that readiness to implement the *Merdeka* Curriculum must be instilled during prospective teacher education, as demonstrated by Titin et al. (2025), who argue that strengthening prospective teachers' holistic understanding of the *Merdeka* Curriculum is necessary to ensure they are conceptually ready and practically skilled.

**Table 8**. Obstacles encountered during the implementation of the *Merdeka* Curriculum

| No. | Category | Obstacle | Representative Quote(s) |
|---|---|---|---|
| 1 | Curriculum understanding and regulations adaptation challenges | Teachers' limited knowledge of the *Merdeka* Curriculum | "*We have not yet fully mastered implementing the* Merdeka *Curriculum in Natural Sciences learning and are still in the process of adapting*" (T8, female, 21–30 years of teaching experience; 2023 phase) |
| | | | "*There are differences from the previous curriculum, and we are not yet accustomed to the* Merdeka *Curriculum system, compounded by time constraints in the classroom*" (T5, male, 6–10 years of teaching experience; 2023 phase) |
| | | Difficulty of understanding the terms in the *Merdeka* Curriculum | "*New terms that are not yet understood and learning activities that are still confusing*" (T7, female, 21–30 years of teaching experience; 2023 phase) |
| | | | "*Because various terms differ from the previous curriculum, and there are also different regulations compared to the previous curriculum*" (T26, female, 16–20 years of teaching experience; 2023 phase) |
| | | Unfamiliarity with P5 and the costs incurred by its implementation | "*Sometimes, the implementation of the* Merdeka *Curriculum is hindered by costs, such as those associated with creating entrepreneurial products*" (T6, female, 1–5 years of teaching experience; 2023 phase) |

| No. | Category | Obstacle | Representative Quote(s) |
|---|---|---|---|
| | | | "*Teachers are not yet familiar with P5, and there are associated costs*" (T9, female, 16–20 years of teaching experience; 2023 phase) |
| | | | "*Projects require extra planning and time; sometimes this conflicts with the essential topics targets*" (T6, female, 1–5 years of teaching experience; 2025 phase) |
| 2 | Pedagogical and assessment challenges | Teachers' lack of proficiency in analyzing learning outcomes to determine essential topics | "*Not all teachers immediately grasp the concepts of learning outcomes, learning objectives flow, and teaching modules, so we need time to adapt*" (T6, female, 1–5 years of teaching experience; 2025 phase) |
| | | | "*Based on experience, teachers must reanalyze the curriculum guidelines, which in turn affects their analysis of learning outcomes, and adapt them to the needs of their students and the school*" (T11, female, 11–15 years of teaching experience; 2023 phase) |
| | | Teachers' lack of proficiency in teaching the topics according to students' level of development | "*Teachers' understanding of the material and concrete methods for teaching Natural Sciences is not yet consistent, making it difficult to align with students' cognitive levels*" (T3, female, 11–15 years of teaching experience; 2025 phase) |
| | | The complexity of designing differentiated learning | "*Students must be guided based on their learning interests, but their interests can sometimes be fickle*" (T23, female, 21–30 years of teaching experience; 2023 phase) |
| | | | "*Differentiated learning requires specific strategies, while the class size is quite large*" (T6, female, 1–5 years of teaching experience; 2025 phase) |
| 3 | Professional support and administrative challenges | Inadequacy of training and mentoring carried out | "*Since I have never attended any training, I am still confused*" (T21, female, 11–15 years of teaching experience; 2023 phase) |
| | | | "*Training is often still general in nature, lacking depth and continuity*" (T6, female, 1–5 years of teaching experience; 2025 phase) |
| | | | "*There is a lack of adequate training and support for teachers regarding the use of technology and the implementation of assessment*" (T3, female, 11–15 years of teaching experience; 2025 phase) |
| | | Difficulty in creating lesson planning documents | "*The challenge lies in the lesson planning documents: even before the implementation of the 2013 Curriculum was complete, the* Merdeka *Curriculum had already replaced it, and what used to be a single-page lesson implementation plan is now a teaching module—since this is a new development, many teachers are still unfamiliar with it and are having to delve deeper into the subject matter and relearn teaching methods*" (T28, male, 21–30 years of teaching experience; 2023 phase) |

| No. | Category | Obstacle | Representative Quote(s) |
|---|---|---|---|
| 4 | Resource and technology challenges | Lack of access to Natural Sciences learning support facilities (such as laboratories) | "*Natural Sciences is closely tied to experimentation, yet not all schools have fully equipped laboratories or adequate materials*" (T6, female, 1–5 years of teaching experience; 2025 phase) |
| | | | "*This is due to inadequate facilities and infrastructure, as well as students' lack of preparation*" (T9, female, 11–15 years of teaching experience; 2025 phase) |
| | | | "*Some of the challenges include a lack of supporting facilities*" (T5, female, 21–30 years of teaching experience; 2025 phase) |
| | | Lack of mastery of technology | "*Challenges in using technology that is not fully understood*" (T2, female, 21–30 years of teaching experience; 2023 phase) |
| | | | "*Teachers' lack of information technology skills*" (T5, female, 21–30 years of teaching experience; 2025 phase) |
| | | Essential topics limits the information included in governmental learning resources | "*The problem arises because the textbooks or teaching materials used contain only essential topics—material that consists solely of outlines and is brief—so teachers must look for additional material from other sources*" (T25, female, 21–30 years of teaching experience; 2023 phase) |

Natural Sciences teachers in junior high schools in Pontianak City have made various efforts to address the obstacles they face. Teachers have increased independent learning to access information related to the *Merdeka* Curriculum through various platforms and social media. One platform that has become a hub for teachers to learn about the *Merdeka* Curriculum is the *Merdeka Mengajar* Platform (*Platform Merdeka Mengajar*, hereinafter mentioned as PMM). The PMM helps teachers accelerate the implementation of the *Merdeka* Curriculum and improve the quality of learning (Keisha et al., 2024; Krismiyati, 2025). As a platform that supports teachers in competency development, PMM also provides various learning resources, such as teaching modules, teaching materials, and learning assessments, which can be used directly by teachers or customized to their needs. Other efforts include discussions with colleagues, collaboration with teachers at school and in MGMP, optimization of available resources at school, and active participation in training and mentoring related to the *Merdeka* Curriculum. Regarding the costs of implementing P5, teachers try to communicate them to students' parents, as seen in one of the teachers' responses: "*Communicating with parents about costs*" (T9, female, 16–20 years of teaching experience; 2023 phase). Thus, these efforts indicate that Natural Sciences teachers in junior high schools in Pontianak City have also adapted to the implementation of the *Merdeka* Curriculum as implementers of the regulations in the real teaching practices.

Overall, the impacts and obstacles felt by Natural Sciences teachers in junior high schools in Pontianak City show that the *Merdeka* Curriculum provides more space for teachers to design and implement innovative and participatory learning, supporting the more advanced development of students in contributing to improving learning activities and overcoming learning loss, which is a national issue. Tapung (2025) noted that the *Merdeka* Curriculum is designed with the primary objective of cultivating a resilient and socially adept generation grounded in Pancasila values, through learning that prioritizes students' holistic development. However, there are still many obstacles to implementing the *Merdeka* Curriculum that must be addressed to optimize it. These findings align with the results of research by Angela et al. (2024) and Firdaus et al. (2024), which found that schools in Pontianak City continue to face obstacles in implementing the *Merdeka* Curriculum. Therefore, follow-up actions are needed

to minimize these obstacles and ensure optimal implementation of the *Merdeka* Curriculum.

**Overall Results and Implications on the Implementation of the *Merdeka* Curriculum in Natural Sciences Subject**

Overall, this research provides a comprehensive picture of the situation, needs, and readiness of seventh-grade Natural Sciences teachers in junior high schools in Pontianak City to implement the *Merdeka* Curriculum and to conduct learning in accordance with its philosophies. By synthesizing the findings based on the results of questionnaires and brief interviews, this research provides evidence that the implementation of the *Merdeka* Curriculum in the seventh-grade Natural Sciences learning in Pontianak City experiences various complexities influenced by constantly changing curriculum regulations, the beliefs and pedagogical competencies of each teacher, school support, and the availability of learning resources that can support the achievement of learning outcomes. This is supported by Molnár et al. (2023), who state that teaching Natural Sciences has become a serious challenge because it cannot succeed without an understanding of the complexities of the systems it encompasses. Across all data sources, the implementation of the *Merdeka* Curriculum emerged as a dominant systemic driver in shaping the planning and implementation of Natural Sciences learning. All teachers participating in this research stated that, as of 2025, they have formally implemented the *Merdeka* Curriculum and reported consistency in its core principles—flexibility in learning design, a focus on students with teachers acting only as facilitators, an orientation toward teacher competencies, and character-based learning—that give them greater autonomy. However, the greater autonomy in the *Merdeka* Curriculum certainly poses various challenges in its implementation in the seventh-grade Natural Sciences subject, especially in schools with limited professional development opportunities or insufficient collaborative structures to support curriculum implementation. Although the understanding and skills of Natural Sciences teachers in Pontianak City junior high schools regarding the implementation of the *Merdeka* Curriculum in seventh-grade Natural Sciences learning have improved, not all teachers feel prepared to translate the expectations of the *Merdeka* Curriculum into concrete learning practices. Therefore, although the readiness to implement the *Merdeka* Curriculum has been achieved at the institutional level, the readiness of seventh-grade Natural Sciences teachers in Pontianak City to implement it remains uneven. Overall, this research demonstrates that seventh-grade Natural Sciences teachers in Pontianak City junior high schools are navigating a transitional phase, in which they have become increasingly aware of the demands over time but have not yet optimized their efforts and therefore require more structured support.

This research offers novelty by being the first to analyze how the *Merdeka* Curriculum is implemented in the seventh-grade Natural Sciences in junior high schools in Pontianak City, using a temporal-comparative perspective, assessing its implementation during the initial adoption in 2023 and in 2025. The findings provide a comprehensive understanding of how the core principles of the *Merdeka* Curriculum are interpreted and translated into real classroom practices in Pontianak City, particularly in the seventh-grade Natural Sciences subject. The results obtained illustrate not only the strategies that Natural Sciences teachers in Pontianak City employ to adapt to changes in the curriculum over time, but also the obstacles they encounter. Such a holistic representation of experiences contributes new empirical insights into the implementation landscape of the Natural Sciences subject under the *Merdeka* Curriculum. Moreover, this research highlights the need for sustainable professional development for Natural Sciences teachers in Pontianak City. The results imply that while teachers generally understand the expectations of the *Merdeka* Curriculum, many still require structured, ongoing training and mentoring to implement its elements effectively, particularly in differentiated learning and assessment development. Therefore, it is urgent to understand that the successful implementation of the *Merdeka* Curriculum depends not only on the dissemination of policies but also on consistent monitoring, adequate learning resources, and support systems from both internal and external sources within the school. In sum, this research has meaningful

implications for policies, school leadership, and teacher education study programs regarding the strengthening of understanding of the *Merdeka* Curriculum. By revealing how the *Merdeka* Curriculum unfolds at the classroom level, this research articulates findings that suggest how seventh-grade Natural Sciences can be supported to deliver high-quality learning aligned with the curriculum's core principles.

**Limitations and Future Directions**

The findings of this research acknowledge several limitations. The first limitation is that the analysis was conducted exclusively from the perspective of teachers. To obtain a more holistic understanding, future research are encouraged to incorporate the perspectives of students, parents, and school principals. Students can offer valuable insights into their engagement with the designed learning process and the extent to which the *Merdeka* Curriculum fosters meaningful experiences. Parents can provide information about home–school dynamics, such as the level of support and communication, as well as their expectations for the learning progress at school. Principals can contribute strategic perspectives related to leadership in schools, support at the institutional level, allocation of learning resources, and alignment of the curriculum's policies with the school system, which can influence the *Merdeka* Curriculum implementation. The second limitation is that the scope of this research was limited to the Natural Sciences subject. While this focus provides a crucial foundation for understanding the progress of Natural Sciences teachers in implementing the *Merdeka* Curriculum exclusively in the Natural Sciences subject, it does not capture how the said curriculum is operationalized across different subjects, each of which may present unique challenges and demands. Therefore, future research could expand the analysis to other subjects, such as Biology. The third limitation is that this research was conducted, capturing the implementation up to the year 2025. Given that the implementation of the *Merdeka* Curriculum has been shown to involve dynamic, evolving processes, it is recommended that subsequent research adopt a longitudinal approach to continuously monitor its implementation in junior high schools in Pontianak City beyond 2025. The fourth limitation is that quantitative analysis is limited to simple descriptive statistics, underscoring the need for future research that assesses quantitative data using advanced inferential statistics to obtain more robust, generalizable data.

## CONCLUSION

Through a temporal-comparative perspective, this research reveals notable differences between the initial adoption assessed in 2023 and the implementation in 2025, demonstrating how Natural Sciences teachers' instructional decisions have evolved. The differences emphasize that implementing the *Merdeka* Curriculum requires sustained professional development, updates on policy changes, and structured support systems to ensure consistency while aligning with its core principles. The results conclude that teachers have increasingly understood the principles of the *Merdeka* Curriculum, supporting a more established implementation in 2025. The flexibility of learning planning, the diversification of innovative learning models, and continuous assessment as support for student development are leading indicators that Natural Sciences teachers in junior high schools in Pontianak City have effectively implemented the *Merdeka* Curriculum. In addition, teachers perceived reports and estimates of improvements in learning outcomes and in the achievement of learning activities, confirming the role of the *Merdeka* Curriculum as a framework that emphasizes student-centered learning and plays a meaningful role in overcoming learning loss after the COVID-19 pandemic. However, teachers are not immune to obstacles hindering the optimal implementation of the *Merdeka* Curriculum, underscoring the need for follow-up actions.

## RECOMMENDATION

This research has limitations, as the analysis was conducted only on teachers. Therefore, it is recommended to conduct a comprehensive analysis of the implementation of the *Merdeka* Curriculum, including perspectives from students, parents, and principals, to gain a broader

picture of learning motivation, student involvement, and the dynamics between students' families and schools. In addition, the analysis was limited to the Natural Sciences subject. Future research can examine the implementation of the *Merdeka* Curriculum in other subjects, such as Biology. In addition, it is recommended that follow-up research be conducted in a similar longitudinal design to monitor the implementation of the *Merdeka* Curriculum in junior high schools in Pontianak City after 2025.

**ACKNOWLEDGMENTS**
The authors would like to express their gratitude to all the seventh-grade Natural Sciences teachers in junior high schools in Pontianak City who participated in this research.

**FUNDING INFORMATION**
The authors would like to express their appreciation for this research being funded by the Non-tax State Revenue of the Faculty of Teacher Training and Education, Universitas Tanjungpura, in the 2023 fiscal year through the faculty's decree with the number 1081/UN22.6/PT.01.05/2023.

**AUTHOR CONTRIBUTIONS STATEMENT**

| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kurnia Ningsih | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Anisyah Yuniarti | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | |
| Mas Akhbar Faturrahman | ✓ | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | ✓ | | | |
| Dian Wahyuningsih | | ✓ | | | | | | | | ✓ | ✓ | | | |

**CONFLICT OF INTEREST STATEMENT**
The authors would like to declare that there are no conflicts of interest regarding this research.

**INFORMED CONSENT**
The authors would like to declare that informed consent has been obtained from each teacher and the respective schools overseeing them who have participated in this research.

**ETHICAL APPROVAL**
The authors would like to declare that, prior to data collection, they obtained official permission through a research permit letter authorizing the research in participating schools. Coordination with schools and teachers was conducted to facilitate the smooth implementation of research activities. All information regarding the schools and teachers was kept strictly confidential to maintain anonymity and follow ethical standards in educational research. Participation was completely voluntary.

**DATA AVAILABILITY**
The authors would like to declare that the data that support the findings of this research are available upon reasonable request from the corresponding author, Anisyah Yuniarti. The data, which contain information that could compromise the privacy of research respondents, are not publicly available due to certain restrictions.

## REFERENCES

Afriadi, B., Komarudin, K., & Sutisna, A. (2024). Evaluation of the effectiveness of the civic education curriculum in Indonesia: A case study of the KTSP curriculum, the 2013 curriculum, and the independent curriculum. *Journal of Curriculum and Teaching, 13*(5), 331–343. https://doi.org/10.5430/jct.v13n5p331

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement, 45*(1), 131–142. https://doi.org/10.1177/0013164485451012

Almanasreh, E., Moles, R., & Chen, T. F. (2019). Evaluation of methods used for estimating content validity. *Research in Social and Administrative Pharmacy, 15*(2), 214–221. https://doi.org/10.1016/j.sapharm.2018.03.066

Alvina, S., Mellyzar, M., & Zahara, S. R. (2025). Hands-on, minds-on: The impact of home-based experiments on scientific process skills of Indonesian middle school students. *Science Education International, 36*(3), 341–348. https://doi.org/10.33828/sei.v36.i3.9

Andrietti, V., & Su, X. (2019). Education curriculum and student achievement: Theory and evidence. *Education Economics, 27*(1), 4–19. https://doi.org/10.1080/09645292.2018.1527894

Angela, Y., Kartono, K., & Ghasya, D. A. V. (2024). Analisis implementasi Kurikulum Merdeka pada pembelajaran IPAS di kelas IV Sekolah Dasar Negeri 28 Pontianak Kota. *FONDATIA, 8*(4), 860–880. https://doi.org/10.36088/fondatia.v8i4.5510

Arifin, S., Setyosari, P., Sa'dijah, C., & Kuswandi, D. (2020). The effect of problem-based learning by cognitive style on critical thinking skills and students' retention. *Journal of Technology and Science Education, 10*(2), 271–281. https://doi.org/10.3926/jotse.790

Astuti, M., Ismail, F., Fatimah, S., Puspita, W., & Herlina, H. (2024). The relevance of the Merdeka Curriculum in improving the quality of Islamic education in Indonesia. *International Journal of Learning, Teaching and Educational Research, 23*(6), 56–72. https://doi.org/10.26803/ijlter.23.6.3

Atmojo, I. R. W., Ardiansyah, R., Pramesthi, A. D., Adi, F. P., & Rukayah, R. (2025). The effect of project-based learning model based on differentiation learning on creative thinking skills in science learning. *Multidisciplinary Science Journal, 7*(4), Article e2025151. https://doi.org/10.31893/multiscience.2025151

Aygören, F., & Er, K. O. (2019). New approach at evaluating the private schools' curriculum: I-CODE model. *Turkish Online Journal of Educational Technology, 18*(2), 58–81. https://www.tojet.net/articles/v18i2/1826.pdf

Ayu, N. A. K., Ningsih, K., Yuniarti, A., & Haruno, M. (2026). Feasibility of a quantitative literacy-based student worksheet for endocrine system practical lessons. *JPBI (Jurnal Pendidikan Biologi Indonesia), 12*(1), 199–219. https://doi.org/10.22219/jpbi.v12i1.43046

Badan Standar, Kurikulum, dan Asesmen Pendidikan Republik Indonesia. (2022). *Satuan pendidikan pelaksana implementasi Kurikulum Merdeka pada tahun ajaran 2022/2023*. https://kurikulum.kemdikbud.go.id/wp-content/uploads/2022/07/044_H_KR_2022.pdf

Bakhsh, J. T., Robertson, J., & Rowe, K. (2024). Mixed methods in sport management: A review and directions for future research. *Sport Management Review, 27*(5), 682–703. https://doi.org/10.1080/14413523.2024.2347004

Barjum, D. (2022). PDIA for systems change: Tackling the learning crisis in Indonesia. *Research on Improving Systems of Education, 2022*, Article 046. https://doi.org/10.35489/BSG-RISE-RI_2022/046

Beatty, A., Berkhout, E., Bima, L., Pradhan, M., & Suryadarma, D. (2021). Schooling progress, learning reversal: Indonesia's learning profiles between 2000 and 2014. *International Journal of Educational Development, 85*, Article 102436. https://doi.org/10.1016/j.ijedudev.2021.102436

Bilad, M. R., Zubaidah, S., & Prayogi, S. (2024). Addressing the PISA 2022 results: A call for reinvigorating Indonesia's education system. *International Journal of Essential Competencies in Education, 3*(1), 1–12. https://doi.org/10.36312/ijece.v3i1.1935

Cerelia, J. J., Sitepu, A. A., & Toharudin, T. (2021). Learning loss akibat pembelajaran jarak jauh selama pandemi COVID-19 di Indonesia. *Seminar Nasional Statistika X: "The Role of Big Data & Analytics in Start Up Industry on Era Society 5.0,"* 27. https://doi.org/10.1234/pns.v10i.91

Chandra, F. E., Suryadi, D., Dahlan, J. A., Hayuningrat, S., & Rahman, S. (2025). Derivative in Indonesian textbook curricula: A praxeological analysis of learning obstacles in Indonesian mathematics textbooks. *Eurasia Journal of Mathematics, Science and Technology Education, 21*(5), Article em2627. https://doi.org/10.29333/ejmste/16256

Chaovanapricha, K., & Chaturongakul, P. (2020). Interdisciplinary teacher collaboration in English for specific purposes subjects in a Thai university. *English Language Teaching, 13*(5), 139–148. https://doi.org/10.5539/elt.v13n5p139

Crawford, L. K., Carmona, K. A., & Kumar, R. (2024). Examining the impact of project-based learning on students' self-reported and actual learning outcomes. *Pedagogy in Health Promotion, 10*(4), 241–249. https://doi.org/10.1177/23733799241234065

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Daryanto, D., Agung, I., & Siswantari, S. (2020). MGMP teacher organization empowerment in improving students' problem solving ability. *Journal of Educational and Social Research, 10*(1), 152–166. https://doi.org/10.36941/jesr-2020-0014

Dawson, V., Eilam, E., Tolppanen, S., Assaraf, O. B. Z., Gokpinar, T., Goldman, D., Putri, G. A. P. E., Subiantoro, A. W., White, P., & Quinton, H. W. (2022). A cross-country comparison of climate change in middle school science and geography curricula. *International Journal of Science Education, 44*(9), 1379–1398. https://doi.org/10.1080/09500693.2022.2078011

de Jong, L., Meirink, J., & Admiraal, W. (2019). School-based teacher collaboration: Different learning opportunities across various contexts. *Teaching and Teacher Education, 86*, Article 102925. https://doi.org/10.1016/j.tate.2019.102925

Delita, F., Sidauruk, T., Hanana, A., & Wirda, M. A. (2025). Factors influencing of teachers' readiness to implement the independent curriculum. *International Journal of Evaluation and Research in Education, 14*(5), 4173–4182. https://doi.org/10.11591/ijere.v14i5.29141

Donnelly, R., & Patrinos, H. A. (2022). Learning loss during COVID-19: An early systematic review. *Prospects, 51*(4), 601–609. https://doi.org/10.1007/s11125-021-09582-6

Edwar, E., Putri, R. I. I., Zulkardi, Z., & Darmowijoyo, D. (2020). MGMP optimization in developing teacher professionalism in developing HOTS problems based on RME approach. *Journal of Physics: Conference Series, 1657*, Article 012022. https://doi.org/10.1088/1742-6596/1657/1/012022

Eliana, E. D. S., Senam, S., Wilujeng, I., & Jumadi, J. (2016). The effectiveness of project-based e-learning to improve ICT literacy. *Jurnal Pendidikan IPA Indonesia, 5*(1), 51–55. https://doi.org/10.15294/jpii.v5i1.5789

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences, 118*(17), Article e2022376118. https://doi.org/10.1073/pnas.2022376118

Fauziah, F. N., Saddhono, K., & Suryanto, E. (2023). Implementation of local wisdom-based Indonesian learning to strengthen Pancasila student profiles (P5): Case studies in vocational high schools. *Journal of Curriculum and Teaching, 12*(6), 283–297. https://doi.org/10.5430/jct.v12n6p283

Firdaus, M., Mania, S., & Rasyid, M. N. A. (2024). Evaluasi implementasi Kurikulum Merdeka di SMP Kota Pontianak melalui pendekatan Provus' discrepancy. *Edukasi: Jurnal Pendidikan, 22*(1), 117–131. https://doi.org/10.31571/edukasi.v22i1.7419

Frigerio, D., Richter, A., Per, E., Pruse, B., & Vohland, K. (2021). Citizen science in the natural sciences. In K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponti, R. Samson, & K. Wagenknecht (Eds.), *The science of citizen science* (pp. 79–96). Springer. https://doi.org/10.1007/978-3-030-58278-4_5

Gizaw, G. G., & Sota, S. S. (2023). Improving science process skills of students: A review of literature. *Science Education International, 34*(3), 216–224. https://doi.org/10.33828/sei.v34.i3.5

Haser, Ç., Doğan, O., & Erhan, G. K. (2022). Tracing students' mathematics learning loss during school closures in teachers' self-reported practices. *International Journal of Educational Development, 88*, Article 102536. https://doi.org/10.1016/j.ijedudev.2021.102536

Hogan, D., & O'Flaherty, J. (2022). Exploring the nature and culture of science as an academic discipline: Implications for the integration of education for sustainable development. *International Journal of Sustainability in Higher Education, 23*(8), 120–147.

https://doi.org/10.1108/IJSHE-06-2021-0236

Indriani, C., Hidayat, S., & Astriani, M. (2025). Improving learning outcomes through discovery learning on the human respiratory system material. *Journal of Education and Learning, 19*(3), 1307–1316. https://doi.org/10.11591/edulearn.v19i3.20987

Islami, R. A. Z. El, Xue, S., Sari, I. J., Ngan, L. H. M., Khwaengmake, V., Khan, S., Van Bien, N., Faikhamta, C., Khuyen, N. T. T., & Prasoplarb, T. (2022). A comparison of school science curricula of Indonesia, Vietnam, and Thailand. *Asia-Pacific Social Science Review, 22*(2), Article 6. https://doi.org/10.59588/2350-8329.1421

Jirana, J., Amin, M., Suarsini, E., & Lukiati, B. (2020). Implementation of project based learning (PBL) model for critical thinking skills and creativity stimulation as a prospective biology teacher. *Systematic Reviews in Pharmacy, 11*(6), 1290–1301. https://doi.org/10.31838/srp.2020.6.189

Juniwati, J., Yusrizal, Y., & Khaldun, I. (2020). Influence of the contextual teaching and learning model against student learning outcome. *Journal of Physics: Conference Series, 1460*, Article 012128. https://doi.org/10.1088/1742-6596/1460/1/012128

Karpudewan, M., Ponniah, J., & Zain, A. N. M. (2016). Project-based learning: An approach to promote energy literacy among secondary school students. *The Asia-Pacific Education Researcher, 25*(2), 229–237. https://doi.org/10.1007/s40299-015-0256-z

Kasuga, W., Maro, W., & Pangani, I. (2022). Effect of problem-based learning on developing science process skills and learning achievement on the topic of safety in our environment. *Journal of Turkish Science Education, 19*(3), 872–886. https://doi.org/10.36681/tused.2022.154

Keisha, F., Hakim, A. R., Widiarso, B. R., Hermawan, R. Z., Safira, A. M., Azmira, R., & Novianti, P. W. (2024). An automatic document validation system in the Platform Merdeka Mengajar by using word embeddings and supervised classification models. In C. Anutariya, M. M. Bonsangue, E. Budhiarti-Nababan, & O. S. Sitompul (Eds.), *Data science and artificial intelligence: Second International Conference on Data Science and Artificial Intelligence* (pp. 3–16). Springer. https://doi.org/10.1007/978-981-97-9793-6_1

Kementerian Pendidikan Dasar dan Menengah Republik Indonesia. (2025a). *Peraturan Menteri Pendidikan Dasar dan Menengah Nomor 10 Tahun 2025 tentang standar kompetensi lulusan pada pendidikan anak usia dini, jenjang pendidikan dasar, dan jenjang pendidikan menengah*. https://peraturan.bpk.go.id/Details/321419/permendikdasmen-no-10-tahun-2025

Kementerian Pendidikan Dasar dan Menengah Republik Indonesia. (2025b). *Peraturan Menteri Pendidikan Dasar dan Menengah Nomor 13 Tahun 2025 tentang perubahan atas Peraturan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 12 Tahun 2024 tentang kurikulum pada pendidikan anak usia dini, jenjang pendidikan dasar, dan jenjang pendidikan menengah*. https://peraturan.bpk.go.id/Details/322506/permendikdasmen-no-13-tahun-2025

Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia. (2024). *Peraturan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 12 Tahun 2024 tentang kurikulum pada pendidikan anak usia dini, jenjang pendidikan dasar, dan jenjang pendidikan menengah*. https://peraturan.bpk.go.id/Details/281847/permendikbudriset-no-12-tahun-2024

Khery, Y., Ahzan, S., Efendi, I., Nufida, B. A., Dasna, I. W., Megapratiwi, F. I., Cahayani, L., & Febriani, N. (2024). Teacher readiness on promoting Merdeka Curriculum considering experience in implementing science process skill and scientific literacy learning. *AIP Conference Proceedings, 3106*, Article 070019. https://doi.org/10.1063/5.0215147

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine, 15*(2), 155–163.

https://doi.org/10.1016/j.jcm.2016.02.012
Krismiyati, K. (2025). Technology readiness segment analysis of teachers in using mobile-based teaching applications: An Indonesian context. *Journal of Technology and Science Education, 15*(2), 588–601. https://doi.org/10.3926/jotse.3431
Kusumawati, E., Suswandari, S., & Umam, K. (2025). Strengthening teacher competence for leading and sustaining the implementation of the Merdeka Curriculum. *Cogent Education, 12*(1), Article 2501458. https://doi.org/10.1080/2331186X.2025.2501458
Lepareur, C., & Grangeat, M. (2018). Teacher collaboration's influence on inquiry-based science teaching methods. *Education Inquiry, 9*(4), 363–379. https://doi.org/10.1080/20004508.2018.1428037
Levy-Feldman, I. (2025). The role of assessment in improving education and promoting educational equity. *Education Sciences, 15*(2), Article 224. https://doi.org/10.3390/educsci15020224
Liontou, M. (2021). Conceptions of assessment as an integral part of language learning: A case study of Finnish and Chinese university students. *Languages, 6*(4), Article 202. https://doi.org/10.3390/languages6040202
Maba, W., Widiastuti, I. A. M. S., Mantra, I. B. N., Suartama, I. K., & Sukanadi, N. L. (2023). Learning loss: Impact of the COVID-19 pandemic on the students' psychosocial condition. *Journal of Education and E-Learning Research, 10*(2), 209–214. https://doi.org/10.20448/jeelr.v10i2.4543
Marlina, R., Suwono, H., Ibrohim, I., Yuenyong, C., Hamdani, H., & Pamungkas, R. (2025). CRTP: Learning model for integrating STEM competencies in pre-service biology teachers. *Journal of Education and Learning, 19*(3), 1466–1473. https://doi.org/10.11591/edulearn.v19i3.21818
Maylawati, D. S., Mulyana, R., Rizqullah, N., Nurjaman, I., & Ramdhani, M. A. (2025). Assessing Indonesian Islamic schools' readiness for the independent curriculum using text analytics. *Multidisciplinary Reviews, 8*(10), Article e2025336. https://doi.org/10.31893/multirev.2025336
Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications.
Milligan, B. G., & Rohde, A. T. (2024). Why more biologists must embrace quantitative modeling. *Integrative and Comparative Biology, 64*(3), 975–986. https://doi.org/10.1093/icb/icae038
Molnár, Z., Gyuris, Á., Radács, M., Nemes, P., Bátori, I., & Gálfi, M. (2023). Complex natural science and the challenges of its education in the 21st century. *Cogent Education, 10*(2), Article 2240166. https://doi.org/10.1080/2331186X.2023.2240166
Montenegro-Rueda, M., Luque-de la Rosa, A., Sánchez-Serrano, J. L. S., & Fernández-Cerero, J. (2021). Assessment in higher education during the COVID-19 pandemic: A systematic review. *Sustainability, 13*(19), Article 10509. https://doi.org/10.3390/su131910509
Mora-Ruano, J. G., Heine, J.-H., & Gebhardt, M. (2019). Does teacher collaboration improve student achievement? Analysis of the German PISA 2012 sample. *Frontiers in Education, 4*, Article 85. https://doi.org/10.3389/feduc.2019.00085
Mulyeni, T., Jamaris, M., & Supriyati, Y. (2019). Improving basic science process skills through inquiry-based approach in learning science for early elementary students. *Journal of Turkish Science Education, 16*(2), 187–201. https://doi.org/10.12973/tused.10274a
Muraleedharan, A., Ragavan, S., Bage, N. N., & Devi, R. (2022). Perceptions of medical undergraduate students on curricular changes in anatomy: An embedded design mixed method study. *Journal of Advances in Medical Education & Professionalism, 10*(1), 22–29. https://doi.org/10.30476/JAMP.2021.92149.1472
Ndari, W., Suyatno, S., Sukirman, S., & Mahmudah, F. N. (2023). Implementation of the

Merdeka Curriculum and its challenges. *European Journal of Education and Pedagogy, 4*(3), 111–116. https://doi.org/10.24018/ejedu.2023.4.3.648

Ningsih, K., Yuniarti, A., Supriatno, B., Faturrahman, M. A., & Haruno, M. (2025). Quantitative literacy-based laboratory activity design on the effect of color spectra on photosynthetic rate. *Biosaintifika: Journal of Biology & Biology Education, 17*(3), 442–454. https://doi.org/10.15294/biosaintifika.v17i3.23949

Nurulwati, N., Herliana, F., Elisa, E., & Musdar, M. (2021). The effectiveness of project-based learning to increase science process skills in static fluids topic. *AIP Conference Proceedings, 2320*, Article 020037. https://doi.org/10.1063/5.0037628

Organisation for Economic Co-operation and Development. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. https://www.oecd.org/en/publications/pisa-2022-results-volume-i_53f23881-en.html

Parahita, B. N., Astutik, D., Ghufronudin, G., & Yuhastina, Y. (2023). Learning loss experience and control motive by zillennial generation in Indonesia. *International Journal of Evaluation and Research in Education, 12*(1), 346–356. https://doi.org/10.11591/ijere.v12i1.23824

Pečiuliauskienė, P., Kaminskienė, L., & Lehtinen, E. (2023). Science teachers' collaborative innovative activities: The role of professional development and professional experience. *Humanities and Social Sciences Communications, 10*(1), 1–10. https://doi.org/10.1057/s41599-023-01833-5

Pek, L. S., Nadarajan, N.-T. M., Khusni, H., Mee, R. W. M., Ismail, M. R., Adha, N. S. Q. S., & Arma, A. E. S. A. J. (2024). Factors contributing to learning losses among primary school children: A scoping review. *Journal of Education and Learning, 18*(3), 840–847. https://doi.org/10.11591/edulearn.v18i3.21305

Permana, R. C., Hanum, F., Bakhtiar, T., & Supriyo, P. T. (2025). Optimasi penjadwalan mata pelajaran berbasis Kurikulum Merdeka menggunakan integer linear programming. *Euler: Jurnal Ilmiah Matematika, Sains dan Teknologi, 13*(2), 202–210. https://doi.org/10.37905/euler.v13i2.32513

Permanasari, A., Rubini, B., Pursitasari, I. D., Nurramadhani, A., Hadiana, D., Suwarma, I. R., & Kumano, Y. (2024). Fun classroom: How seven grades and science teachers respond to STEM learning as the first experience in suburban area? *Jurnal Pendidikan IPA Indonesia, 13*(1), 55–63. https://doi.org/10.15294/jpii.v13i1.47386

Permatasari, C. L., Nababan, K. R., & Junius, R. (2025). Developing a Merdeka Curriculum learning assessment system to facilitate teachers' performance. *The International Journal of Assessment and Evaluation, 32*(2), 193–223. https://doi.org/10.18848/2327-7920/CGP/v32i02/193-223

Putri, F., & Suwono, H. (2023). Implementation of PBL (problem-based learning) to improve interdisciplinary thinking skills and biology learning outcomes. *AIP Conference Proceedings, 2569*, Article 020012. https://doi.org/10.1063/5.0112276

Rachman, A., Putro, H. Y. S., Rusandi, M. A., & Situmorang, D. D. (2024). The development and validation of the "Kuesioner Tema Proyek Penguatan Profil Pelajar Pancasila" (KT P5): A new tool for strengthening the Pancasila student profile in Indonesian pioneer schools. *Heliyon, 10*(16), Article e35912. https://doi.org/10.1016/j.heliyon.2024.e35912

Rahmah, L., Purwanta, E., Wijayanti, W., & Suhardiman, S. (2024). Navigating the curriculum landscape: The impact of Curriculum 2013 and Merdeka Curriculum on teachers' and students' learning outcomes in Indonesia. *Journal of Ecohumanism, 3*(6), 917–930. https://doi.org/10.62754/joe.v3i6.4061

Ramadhan, I., Imran, I., & Suriyanisa, S. (2024). Implementation of Kurikulum Merdeka at SMA Negeri 1 Pontianak. *Inovasi Kurikulum, 21*(2), 925–940. https://doi.org/10.17509/jik.v21i2.68857

Riana, I. G. A., Agung, A. A. G., & Parmiti, D. P. (2016). Analisis rencana pelaksanaan

pembelajaran (RPP) untuk implementasi Kurikulum 2013 di SD Negeri 3 Banjar Jawa Kecamatan Buleleng tahun pelajaran 2015/2016. *Jurnal Edutech Undiksha, 4*(1), 1–11. https://doi.org/10.23887/jeu.v4i1.20208

Robingatin, R., Mujahidah, M., Sit, M., Veryawan, V., & Hasibuan, R. H. (2025). Perceptions on curriculum implementation: A case of early childhood in Indonesia development teachers as agents of change. *Asia-Pacific Journal of Research in Early Childhood Education, 19*(2), 157–180. https://doi.org/10.17206/apjrece.2025.19.2.157

Rosanawati, I. M. R., Warto, W., Djono, D., & Purwanta, H. (2025). Pedagogical model innovation based on Ki Hajar Dewantara's among system for history learning in the Merdeka Curriculum. *Educational Process: International Journal, 14*, Article e2025039. https://doi.org/10.22521/edupij.2025.14.39

Rosfiani, O., Hermawan, C. M., Sahal, A. L., & Mawartika, N. F. (2020). Inquiry: A learning model to improve the learning outcomes of character. *International Journal of Scientific & Technology Research, 9*(3), 4367–4371. https://www.ijstr.org/final-print/mar2020/Inquiry-A-Learning-Model-To-Improve-The-Learning-Outcomes-Of-Character.pdf

Rosser, A., King, P., & Widoyoko, D. (2022). The political economy of the learning crisis in Indonesia. *Research on Improving Systems of Education, 2022*, Article PE01. https://doi.org/10.35489/BSG-RISE-2022/PE01

Ruiz-Gallardo, J.-R., González-Geraldo, J. L., & Castaño, S. (2016). What are our students doing? Workload, time allocation and time management in PBL instruction: A case study in science education. *Teaching and Teacher Education, 53*, 51–62. https://doi.org/10.1016/j.tate.2015.10.005

Saa, S. (2024). Merdeka Curriculum: Adaptation of Indonesian education policy in the digital era and global challenges. *Revista de Gestão Social e Ambiental, 18*(3), Article e07323. https://doi.org/10.24857/rgsa.v18n3-168

Saputri, A., Satria, I., Nofiani, J., & Fajriyah, R. Z. (2025). Membangun silabus yang kreatif: Menjawab kebutuhan belajar secara personal dan fleksibel. *Future Academia: The Journal of Multidisciplinary Research on Scientific and Advanced, 3*(2), 926–935. https://doi.org/10.61579/future.v3i2.500

Schellekens, L. H., Bok, H. G. J., de Jong, L. H., van der Schaaf, M. F., Kremer, W. D. J., & van der Vleuten, C. P. M. (2021). A scoping review on the notions of assessment as learning (AaL), assessment for learning (AfL), and assessment of learning (AoL). *Studies in Educational Evaluation, 71*, Article 101094. https://doi.org/10.1016/j.stueduc.2021.101094

Septriana, H., Suwandi, S., & Sumarwati, S. (2025). Project-based learning: Improving scientific writing skills with the integration of ecological literacy among students. *Educational Process: International Journal, 15*, Article e2025123. https://doi.org/10.22521/edupij.2025.15.123

Setyawarno, D., Rosana, D., & Kuswanto, H. (2025). "Assessment as learning" in science instruction: A case study of Indonesian science teachers and notion for optimising in teaching and learning process. *Cogent Education, 12*(1), Article 2538337. https://doi.org/10.1080/2331186X.2025.2538337

Sibarani, B. E. (2021). Analysis of the effect of the implementation of the quantum teaching method on accounting learning in class XI IPS SMA N 1 Laguboti. *Aptisi Transactions on Technopreneurship, 3*(1), 1–12. https://doi.org/10.34306/att.v3i1.129

Sofiani, Y., Fachrurozi, M. H., & Armiyati, L. (2025). Reactualization of Sundanese local hero figure's values to foster student character in history education. *Paramita: Historical Studies Journal, 35*(2), 357–370. https://doi.org/10.15294/paramita.v35i2.23800

Suharni, S., Mohamed, S., & Bakar, K. A. (2025). Exploring teachers challenges in implementing literacy and STEAM in early-childhood classrooms. *International Journal*

*of Learning, Teaching and Educational Research, 24*(6), 810–832. https://doi.org/10.26803/ijlter.24.6.37

Sund, P., & Gericke, N. (2020). Teaching contributions from secondary school subject areas to education for sustainable development: A comparative study of science, social science and language teachers. *Environmental Education Research, 26*(6), 772–794. https://doi.org/10.1080/13504622.2020.1754341

Susanti, D., Anand, G., & Arifin, F. A. (2025). Leveraging school principals to address learning loss in Indonesia through group and individual targeting. *International Journal of Educational Development, 112*, Article 103153. https://doi.org/10.1016/j.ijedudev.2024.103153

Suwono, H., Permana, T., Saefi, M., & Fachrunnisa, R. (2023). The problem-based learning (PBL) of biology for promoting health literacy in secondary school students. *Journal of Biological Education, 57*(1), 230–244. https://doi.org/10.1080/00219266.2021.1884586

Suyadi, S., Selvi, I. D., Sibawaihi, S., Zahroh, U., & Muassomah, M. (2023). Children's future adversity: Learning loss risk during online learning in COVID-19 pandemic. *International Journal of Instruction, 16*(2), 457–478. https://doi.org/10.29333/iji.2023.16225a

Syofyan, H., Rosyid, A., Fadli, M. R., & Yusuff, A. A. (2024). Teacher readiness factors that influence the implementation of the Merdeka Curriculum in elementary schools. *Journal of Curriculum and Teaching, 13*(5), 168–180. https://doi.org/10.5430/jct.v13n5p168

Tadesse, T., Ware, H., Asmare, A., & Gillies, R. M. (2024). Enhancing student engagement and outcomes: The effects of cooperative learning in an Ethiopian university's classrooms. *Education Sciences, 14*(9), Article 975. https://doi.org/10.3390/educsci14090975

Tapung, M. (2025). Evaluating the key success factors of "Merdeka" curriculum: Evidence from East Nusa Tenggara, Indonesia. *Journal of Curriculum and Teaching, 14*(2), 88–97. https://doi.org/10.5430/jct.v14n2p88

Titin, T., Ningsih, K., Wahyuni, E. S., Faturrahman, M. A., Uliyanda, D., & Wahyuningsih, D. (2025). Prospective biology teachers' readiness for implementing the Merdeka Curriculum through microteaching learning tools. *Research and Development in Education, 5*(2), 1099–1119. https://doi.org/10.22219/raden.v5i2.42343

Tsihouridis, C. (2024). Upside-down creativity! Reversing science concepts learning for tertiary level students. In *Proceedings of the 26th International Conference on Interactive Collaborative Learning: "Towards a Hybrid, Flexible and Socially Engaged Higher Education"* (pp. 344–355). Springer. https://doi.org/10.1007/978-3-031-53382-2_33

United Nations Educational, Scientific and Cultural Organization. (2020). *Global education monitoring report 2020: Inclusion and education: All means all*. https://doi.org/10.54676/JJNK6989

Valdez, J. E., & Bungihan, M. E. (2019). Problem-based learning approach enhances the problem solving skills in chemistry of high school students. *Journal of Technology and Science Education, 9*(3), 282–294. https://doi.org/10.3926/jotse.631

Viner, R. M., Russell, S. J., Croker, H., Packer, J., Ward, J., Stansfield, C., Mytton, O., Bonell, C., & Booy, R. (2020). School closure and management practices during coronavirus outbreaks including COVID-19: A rapid systematic review. *The Lancet Child & Adolescent Health, 4*(5), 397–404. https://doi.org/10.1016/S2352-4642(20)30095-X

Vittadello, S. T., & Stumpf, M. P. H. (2022). Open problems in mathematical biology. *Mathematical Biosciences, 354*, Article 108926. https://doi.org/10.1016/j.mbs.2022.108926

Wahyuni, E. S., & Faturrahman, M. A. (2024). Analysis of the ability of prospective biology teachers to develop teaching modules on the Kampus Mengajar program. *JPBI (Jurnal*

*Pendidikan Biologi Indonesia), 10*(3), 761–772. https://doi.org/10.22219/jpbi.v10i3.35565

Wardani, H. K., Sujarwo, S., Rakhmawati, Y., & Cahyandaru, P. (2023). Analysis of the impact of the Merdeka Curriculum policy on stakeholders at primary school. *Jurnal Ilmiah Peuradeun, 11*(2), 513–530. https://doi.org/10.26811/peuradeun.v11i2.801

Wardani, N. E., Suwandi, S., & Ulya, C. (2023). Feasibility assessment of Merdeka Curriculum in Bahasa Indonesia digital textbooks for class VII junior high schools. *Theory and Practice in Language Studies, 13*(12), 3268–3278. https://doi.org/10.17507/tpls.1312.25

Wardani, N. E., Suwandi, S., Ulya, C., & Setiyoningsih, T. (2025). Pancasila student profiles in digital textbooks for Indonesian language and literature in Merdeka Curriculum. *Theory and Practice in Language Studies, 15*(7), 2248–2259. https://doi.org/10.17507/tpls.1507.17

Wijarwadi, W., Nguyen, H. T. M., & Alonzo, D. (2025). Teacher collaboration: Conceptualisation and practice. *Professional Development in Education, 51*(6), 1184–1202. https://doi.org/10.1080/19415257.2025.2504693

Wildan, W., Kurniawan, R. A., & Fatriani, E. (2026). Curriculum transitions and teacher adaptability: Examining experience, school demographics, and pedagogical challenges in Indonesia. *Curriculum Perspectives*. Advance online publication. https://doi.org/10.1007/s41297-025-00316-8

Winingsih, L. H., Agung, I., & Sulistiono, A. A. (2019). The influence of government policy, principle leadership, and participation of parents on strengthening teacher organizations (KKG/MGMP) and development of problem solving in students: Indonesia case. *International Journal of Education and Practice, 7*(4), 479–493. https://doi.org/10.18488/journal.61.2019.74.479.493

Wisenöcker, A. S., Helm, C., Große, C. S., Hübner, N., & Zitzmann, S. (2025). A meta-analysis of students' academic learning losses over the course of the COVID-19 pandemic. *Learning and Instruction, 98*, Article 102111. https://doi.org/10.1016/j.learninstruc.2025.102111

Xie, W., Sui, Y., Liu, X., & Liu, S. (2023). Effects of teacher collaboration on teaching practices in China and England: A structural equation model with TALIS 2018 data. *SAGE Open, 13*(2), Article 21582440231177908. https://doi.org/10.1177/21582440231177908

Yusuf, F. M., Nusantari, E., Isnanto, I., Husain, I., & Mustaqimah, N. (2025). The effects of problem-based learning (PBL) model, educational techniques, creative thinking skills, self-confidence and metacognitive skills on students' biology information retention. *Journal of Curriculum and Teaching, 14*(3), 319–341. https://doi.org/10.5430/jct.v14n3p319

Zhdanov, S. P., Baranova, K. M., Udina, N., Terpugov, A. E., Lobanova, E. V., & Zakharova, O. V. (2022). Analysis of learning losses of students during the COVID-19 pandemic. *Contemporary Educational Technology, 14*(3), Article ep369. https://doi.org/10.30935/cedtech/11812