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Merdeka Curriculum Implementation at Secondary Schools: Science Teachers' Perspective

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ABSTRACT

This study examines the challenges in implementing the Merdeka Curriculum in science education at a high school in Sungai Penuh City and a Madrasah Aliyah in Kerinci Regency. Using a qualitative approach through interviews and observations, this study reveals that although most science teachers support the curriculum changes and recognize its potential benefits, there are significant obstacles in their readiness and adaptation to new methods. Key challenges such as limited technological proficiency, reliance on traditional teaching methods, and inadequate facilities impact the effectiveness of curriculum implementation. The study's findings also show variation in the use of technology, with some teachers utilizing tools like projectors and various educational applications, while others continue to rely on conventional approaches. To enhance the implementation process, this study recommends more focused and directed professional development, increased access to technological resources, and better alignment between teaching methods and curriculum goals. Strengthening these areas is essential to overcoming current challenges and improving the quality of science education under the Merdeka Curriculum. Thus, the results of this study can contribute to guiding strategic steps to enhance teaching practices nationwide, aiming to achieve a more inclusive and adaptive education aligned with the vision of the Merdeka Curriculum.

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A. INTRODUCTION

Education underpins various aspects of life and plays a crucial role in the development of individuals and society as a whole. Continuous changes in society present challenges to the education sector, requiring the ongoing development of curricula to meet the needs of relevant stakeholders (National Research Council., 2012; OECD, 2018). Education in Indonesia has shown significant progress and continues to strive to close the gap with other countries (Majety et al., 2023; Nisselle et al., 2021). To bridge this gap, the Indonesian government has taken strategic steps, one of which is the implementation of the Merdeka Curriculum (Benstead et al., 2023). In this context, the Merdeka Curriculum in Indonesia is a significant innovation aimed at preparing a generation to compete in today's digital era. However, the implementation of this curriculum faces certain challenges and obstacles that need to be analyzed in greater depth, especially for science teachers who play a crucial role as the frontline in this educational implementation.

The curriculum is an integral part of education, as evidenced by the numerous curriculum changes that have taken place in Indonesia. These changes reflect the ongoing need to adapt

educational content to the rapid advancements in science and technology. To remain relevant, education systems must continuously integrate the latest technologies to address contemporary challenges (Pranata, Seprianto, et al., 2024). The use of technology in science education not only allows for curriculum updates but also creates opportunities for various innovations and teaching methods in learning (National Research Council., 2012). Therefore, the appropriate application of technology in science education plays a crucial role in preparing students to face the rapid and complex changes of today's modern world. Therefore, the appropriate application of technology in science education plays a crucial role in preparing students to face the rapid and complex changes of today's modern world.

As the curriculum is a vehicle to achieve educational goals, it must be professionally adjusted when these goals evolve (R. N. Putri et al., 2023). The educational curriculum must be tailored to the needs and characteristics of students at the time it is designed. This adaptability is essential for the curriculum to remain relevant and effective in supporting student development. In Indonesia, the educational curriculum has undergone ten major changes, occurring in 1947, 1952, 1964, 1968, 1975, 1984, 1994, 2004, 2006, 2013, and most recently in 2022 (Cholilah et al., 2023). These changes reflect the evolution of education in Indonesia in response to societal needs and developments. Currently, the 2013 curriculum has been transformed into the Merdeka Curriculum as part of the Merdeka Belajar program.

The concept of Merdeka Belajar within the Merdeka Curriculum is an educational innovation aimed at preparing an excellent generation. Merdeka Belajar is a program designed to unlock the potential of both educators and students. The Ministry of Education and Culture introduced four main policies of Merdeka Belajar during coordination meetings with education office heads across Indonesia. These policies include: (1) replacing the National School-Based Exam or *Ujian Sekolah Berbasis Nasional* (USBN) with school-administered assessments; (2) transforming the National Exam or *Ujian Nasional* (UN) from a graduation and student achievement assessment into a minimum competency assessment and character survey; (3) granting teachers the freedom to develop Learning Plans; and (4) loosening regulations for New Student Admissions that were previously based on zoning (Kemendikbud, 2019). These policies are integral to realizing the vision of the Merdeka Curriculum.

The Merdeka Curriculum, currently being implemented in Indonesia, has become a major topic of discussion in the field of education (Hehakaya & Pollatu, 2022). It has garnered attention for its potential to shift the existing educational paradigm. The Merdeka Curriculum encourages a learning environment where students can express their natural abilities in a relaxed, enjoyable, and pressure-free atmosphere. According to (Perkasa & Surono, 2023) the implementation of the Merdeka Curriculum can enhance project-based learning and collaborative activities. And It provides significant benefits for both students and teachers, offering greater opportunities for independent learning. The curriculum's goals include granting schools the flexibility to design curricula that meet local needs and adapt to students' potential and diversity. Even though it has many positive benefits, implementing an Merdeka Curriculum certainly faces various challenges (Saputra et al., 2023). Which will be a challenges for schools, teachers and students, as all three must play active roles in the learning process. Teachers, in particular, have a pivotal role in implementing the curriculum in schools.

Teachers are central to curriculum implementation and are key to achieving educational goals (Hehakaya & Pollatu, 2022). According to Suhandi & Robi'ah (2022), teachers play a critical role in improving the quality of learning through the implementation of the new curriculum. This is especially true for science teachers, who must transform the learning paradigm from a

conventional approach to one that is more inclusive and responsive to students' freedom to learn. As educators, teachers possess essential skills in curriculum development, including understanding student psychology, implementing effective teaching methods, and evaluating student learning outcomes (Mayer, 2011). Teachers should also be empowered to use their professional knowledge, skills, and expertise to effectively deliver the curriculum (OECD, 2018). Their role is crucial at every stage of implementing the Merdeka Curriculum.

Implementing the Independent Curriculum as a new system presents its own challenges for teachers. However, this curriculum also opens up opportunities for teachers to create a learning process based on the principles of Independent Learning. This research aims to explore the challenges faced by science teachers in implementing the Merdeka Curriculum at the high school level. It is hoped that the findings from this analysis will provide insight into the strategies needed to overcome these various obstacles, so that educational goals can be achieved smoothly. By emphasizing the challenges faced, the aim of this research becomes clearer: to identify and understand the obstacles experienced by science teachers in the context of implementing the Independent Curriculum. These efforts will contribute to the development of effective strategies to improve teaching practices in the field and support the achievement of optimal learning outcomes for students.

B. METHODS

This research uses a qualitative approach with a case study design, focusing on the implementation of the Kurikulum Merdeka from the perspective of science teachers at a high school in Sungai Penuh and an Islamic senior high school in Kerinci. The case study aims to capture the complexity of an interesting case, involving exploration of the uniqueness and intricacy of a single case and understanding its activities in a significant context (Stake, 1995). Informants were selected through purposive sampling based on criteria such as a minimum of 5 years of teaching experience in science (physics, chemistry, and biology), have an understanding of the Kurikulum Merdeka, and involvement in curriculum development. Validation of research instruments, including open-ended questionnaires and interview guides, was conducted through expert review by two experts assessing the reliability and relevance of the questions. Data were collected through direct observation at school during break times, open-ended questionnaires, and in-depth interviews. Observations recorded interactions and curriculum implementation, while questionnaires and in-depth interviews explored teachers' perspectives on the challenges and dynamics of the curriculum. Each method was systematically conducted to ensure data consistency and accuracy.

The data collected were analyzed using the thematic analysis method by Braun & Clarke (2006) which involves coding, grouping codes into themes, and reviewing and presenting main themes visually. Thematic analysis was chosen because it can identify key patterns in science teachers' experiences in a deep and comprehensive manner, aligning with the research objective of understanding the challenges and complexities in the implementation of the Kurikulum Merdeka. This study involved six science teachers from two schools with similar curriculum backgrounds. Although the findings of this study are contextual, they offer valuable insights for curriculum implementation in other schools with similar conditions.

C. RESULT AND DISCUSSION

Initial observations indicated that five out of six science teachers supported the curriculum change from K-13 to the Merdeka Curriculum, with only one teacher remaining hesitant. This finding suggests that most teachers recognize the potential of the Merdeka Curriculum to be effectively implemented and to improve the quality of learning. A similar trend was observed in teachers' perceptions of their readiness, with five out of six teachers expressing confidence in their ability to implement the Merdeka Curriculum in science learning at their schools. These findings will be further explored through open-ended questionnaires and interviews.

1. Science Teachers' Preparation for the Merdeka Curriculum Change

The implementation of the Merdeka Curriculum requires a comprehensive and effective approach to the learning process, necessitating thorough preparation, particularly by schools and teachers. The research conducted indicates that science teachers (Biology, Chemistry, and Physics) at a high school in Sungai Penuh City and a Madrasah Aliyah in Kerinci Regency have begun taking preparatory steps to address the curriculum changes and their implementation. As depicted in Figure 1, these teachers have made efforts to enhance their knowledge of Information Technology (IT) and various aspects related to the Merdeka Curriculum. Additionally, they are actively participating in both online and offline training sessions and independently seeking and gathering relevant information about the Merdeka Curriculum through the Merdeka Mengajar Platform (PMM) to deepen their understanding and improve its implementation.

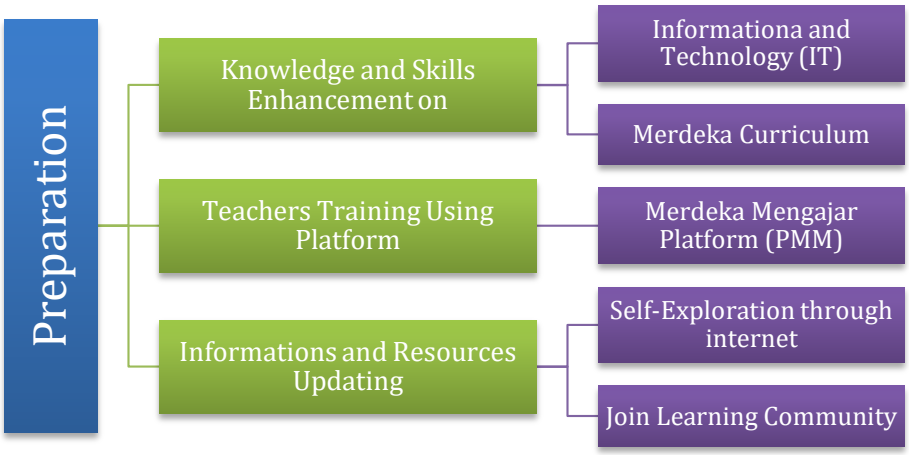

Figure 1. Science Teachers' Preparation for the Merdeka Curriculum Change

The Merdeka Curriculum, which introduces several innovations compared to the K-13 curriculum, requires significant preparation from educators to ensure successful application. One approach to this preparation is through independent training on the Merdeka Mengajar Platform (PMM), provided by the Ministry of Education. This platform offers self-paced training facilities accessible at any time. As a new curriculum, the Merdeka Curriculum demands teachers' readiness and adaptation to technology, requiring them to develop digital literacy, including the four pillars of digital literacy. Teachers still require comprehensive training to gain a deeper understanding of technology use so that they can design and implement creative and effective learning processes aligned with the principles of the new curriculum. The use of technology in assessment implementation is still relatively uncommon among teachers today (Retnawati et al., 2017).

Therefore, further training is necessary for teachers to prepare for the implementation of the Merdeka Curriculum in learning, including training provided by the Merdeka Mengajar Platform (PMM). This training not only deepens teachers' understanding of the principles and objectives of the Merdeka Curriculum but also emphasizes the importance of literacy and technological proficiency as essential components of curriculum adaptation.

Successful implementation of the Merdeka Curriculum in schools requires teachers to prepare various essential elements (Wardani et al., 2023), such as providing teaching materials, including books and modules, developing relevant teaching materials, and applying differentiated learning. In addition to these aspects, teachers must prepare comprehensive teaching plans, understand new learning paradigms, and develop and implement appropriate assessment systems. Moreover, the facilities and infrastructure provided by schools must be adequately prepared to support the effectiveness of the learning process under the new curriculum. However, in preparing and implementing this curriculum, educators face various challenges, whether from the school environment, students, or the teachers themselves.

2. Challenges Faced by Teachers in Implementing the Merdeka Curriculum

This study identifies various challenges faced by science teachers in Biology, Physics, and Chemistry at a high school in Sungai Penuh City, as well as science teachers at a Madrasah Aliyah in Kerinci Regency, in implementing the Merdeka Curriculum. According to Figure 2, the challenges include limitations in facilities such as technology, supporting books, and physical infrastructure, as well as a lack of information and knowledge about the curriculum among educators. Some teachers feel unprepared to adapt to the new teaching methods and tools. Meanwhile, students encounter difficulties in maintaining focus, understanding the material, and adapting to the more independent and creative learning approaches required by the new curriculum. These difficulties reflect broader challenges related to the implementation of innovative curricula, as learning theories suggest that the success of new curriculum implementation is heavily influenced by the readiness and adaptation of both teachers and students to these changes.

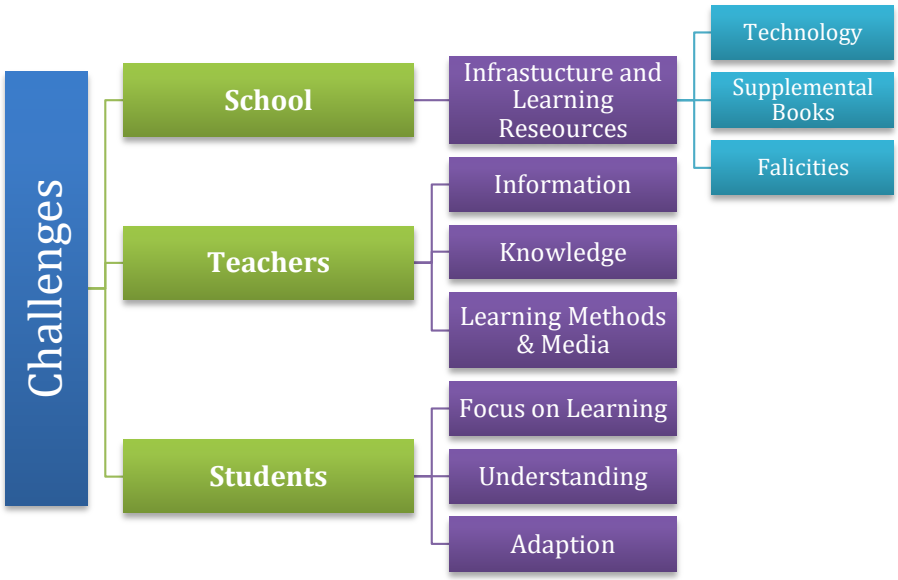

Figure 2. Challenges Faced by Teachers in Implementing the Merdeka CurriculumTantangan

The implementation of the Merdeka Curriculum in schools faces various obstacles and challenges, both individual and institutional. Individual challenges often relate to personal unpreparedness in facing future developments, while institutional challenges stem from the role of teachers as primary facilitators in the learning process and from the schools themselves. Effective implementation of the Merdeka Curriculum requires addressing these challenges by all stakeholders in the school, particularly teachers, who are central to the educational process (Wardani et al., 2023) and external stakeholders, particularly industry stakeholders (Yoto et al., 2024). Teachers must adjust to the transition from the K-13 curriculum to the Merdeka Curriculum, making their readiness to face curriculum changes a crucial factor influencing successful implementation.

The main challenge in implementing the Merdeka Curriculum pertains to teachers' readiness to adapt to this curriculum change. Teachers face difficulties in aligning their teaching methods with the new paradigm during the initial phase of implementation, diverse student abilities, and limited resources (Nurdiyanti et al., 2024). Research by Suhandi & Robi'ah (2022) supports this by showing that several teachers struggle with effectively designing Lesson Plans, indicating a need for adequate training. The lack of readiness to implement the Merdeka Curriculum is often due to insufficient qualifications among those responsible for its implementation (Fajar et al., 2022). This inadequacy can lead to disparities in the quality of teaching and education overall. The successful implementation of the Merdeka Curriculum requires adequate facilities and infrastructure support from schools, which remains a challenge for teachers (Farida et al., 2023). Y. Wulandari et al., (2024) also said that her research showed several challenges faced by teachers including the use of creative teaching methods, school environmental conditions, and limited resources.

Regarding challenges in curriculum implementation, three out of six teachers reported no issues with the curriculum change. However, the remaining three teachers expressed concerns, noting that such changes inevitably present new challenges that must be addressed. Curriculum changes are generally well-considered, aimed at aligning educational conditions with advancements in science and technology. It is crucial for teachers within their communities to collaborate in developing guidelines for curriculum implementation to ensure that standards and goals are clearly understood by all educators (Contant et al., 2018). Transitioning from a traditional learning paradigm to a student-centered approach is a significant challenge for teachers. This shift requires the application of more interactive, participatory, and problem-solving-focused teaching methods. The goals of those methods are to create dynamics classroom atmosphere, active learning, and indirectly increase learner engagement (Amiruddin et al., 2023; Samsudi et al., 2024). Previous study inform that active learning have positive and significant correlation with students' learning outcomes in learning science (Pranata, et al., 2024). In this context, it is essential to explore the strategies employed by science teachers at the high school in Sungai Penuh City and the Madrasah Aliyah in Kerinci Regency for effectively implementing the new curriculum in the classroom, especially with student-centered approach.

3. Strategies Applied by Teachers in Implementing the Merdeka Curriculum

In implementing the Merdeka Curriculum at a high school in Sungai Penuh City and a Madrasah Aliyah in Kerinci Regency, science teachers in Biology, Physics, and Chemistry have employed various strategies to enhance the effectiveness of classroom learning. As illustrated in Figure 3, these teachers act as architects or designers of learning by drawing on practices from other educational institutions and engaging in discussions and collaborations with fellow

educators to adapt teaching methods and materials. They also provide initial information about the Merdeka Curriculum to students, create opportunities for students to express their independent opinions about the material, and group students based on their learning styles. These strategies reflect a thoughtful adjustment to the new curriculum with the goal of optimizing student engagement and learning outcomes.

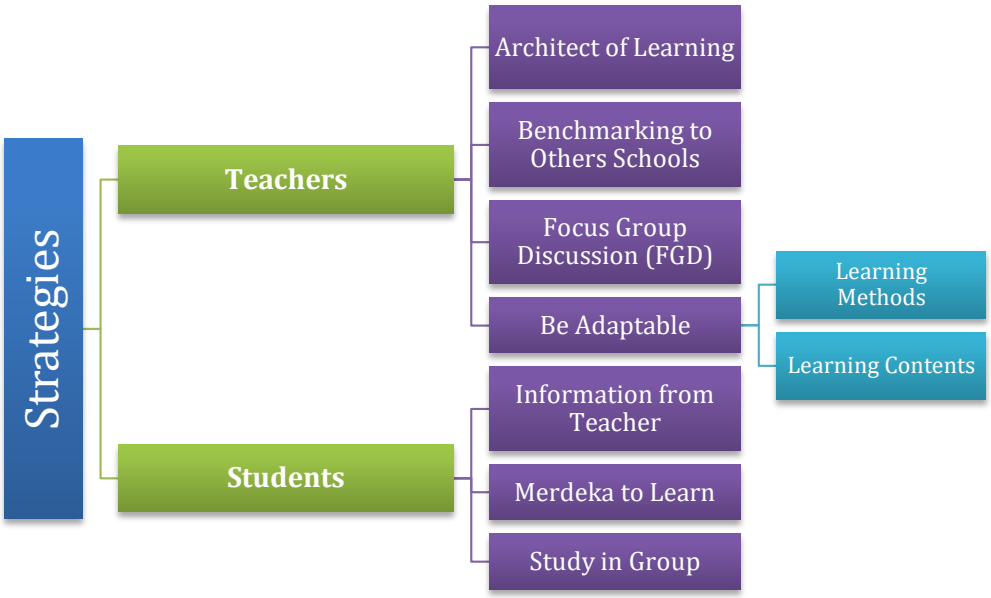

Figure 3. Strategies Applied by Teachers in Implementing the Merdeka Curriculum

The implementation strategies involve planning activities designed to execute the curriculum effectively and efficiently, significantly impacting changes in student behavior (Harwisaputra et al., 2024). Effective learning design requires managing communication patterns between teachers, students, learning resources, and the environment based on psychological approaches. Learning is not conducted entirely independently by students; rather, it involves interaction with various elements, including teachers. In the context of the Merdeka Curriculum, teachers play a crucial role in ensuring that learning activities are effective and efficient, and in maintaining communication patterns between all parties involved. Teachers should be empowered to articulate learning objectives, design teaching materials, select appropriate strategies, and establish evaluation criteria and rationales. As curriculum designers, teachers are responsible for developing and adapting teaching methods and materials to align with students' needs and the learning environment (Fatmawati, 2021). This includes understanding students' characteristics, students' emotion (Pranata, et al., 2023; Seprianto et al., 2024), and the learning context to ensure that the material is well-received and relevant to their development. Therefore, teachers need to employ various innovative and effective methods and approaches.

Learning strategies are defined as methods chosen by teachers to facilitate and support students in achieving learning goals. In science education, learning strategies are generally divided into two categories: direct and indirect strategies. Direct learning strategies involve teachers assigning specific tasks to students with direct supervision, while indirect strategies promote more independent student work. These strategies need to be updated and applied continuously, especially in schools that are adapting to changing times. Implementing the curriculum involves not only applying it in the learning process but also significantly influencing students' behavioral

changes (Sudirman, 2019). Optimal selection of learning strategies should be supported by effective teaching methods tailored to students' characteristics and needs.

4. Teaching Methods and Key Characteristics in Method Selection

The research findings reveal differences in teaching methods applied by science teachers at a high school in Sungai Penuh City compared to a Madrasah Aliyah (MA) in Kerinci Regency. At the high school, teachers have adopted new teaching methods in alignment with the Merdeka Curriculum. In contrast, at the MA, despite the curriculum change, teachers continue using methods from the previous curriculum due to ongoing adaptation processes for both teachers and students. As shown in Figure 4, the choice of teaching methods is influenced by several factors. First, the characteristics of students, including their backgrounds and individual abilities; second, the situation and conditions of the teaching and learning environment; third, the availability of supporting facilities and infrastructure; and fourth, grouping students based on their different learning styles. These factors reflect efforts to align teaching methods with students' individual needs and the specific context and conditions of each school.

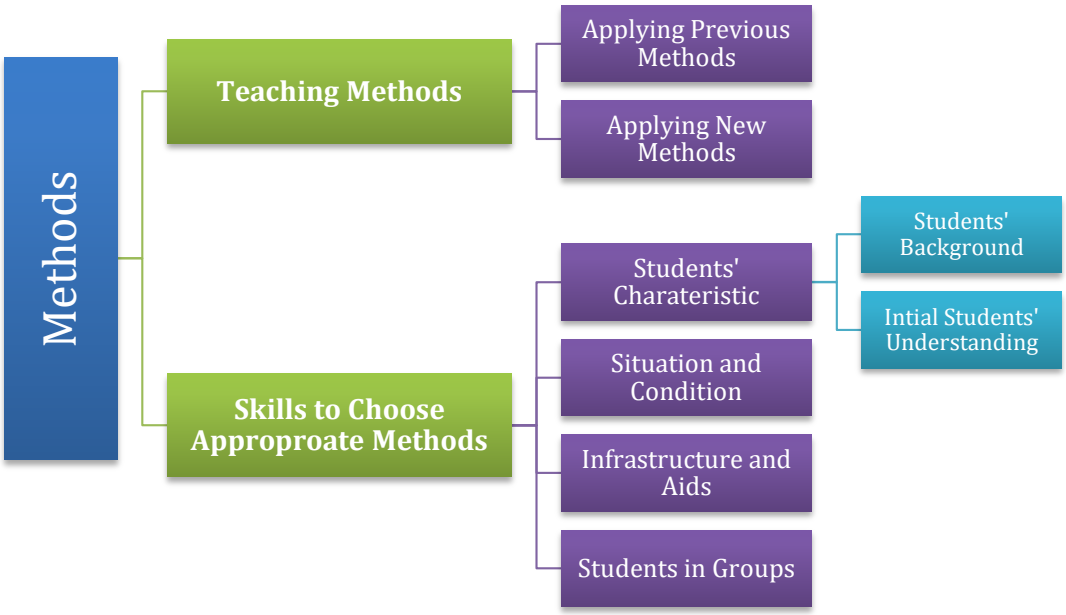

Figure 4. Teaching Methods and Key Characteristics in Method Selection

The study uncovers significant differences in the application of teaching methods between the high school and the Madrasah Aliyah. Teachers at the high school have successfully implemented methods in accordance with the Merdeka Curriculum, whereas adaptation at the Madrasah Aliyah is still progressing slowly. This suggests that the implementation of a new curriculum can be impeded by the readiness of both teachers and students to adapt. Hehakaya & Pollatu (2022) note that some teachers have not fully mastered effective teaching media, which affects their ability to apply methods as required by the Merdeka Curriculum. Additionally, Rusmiati et al., (2023) report that teachers' understanding of learning models aligned with the Merdeka Learning approach remains limited. The quality of learning depends on applying methods that match learning needs (Cahyani & Pranata, 2023). Incompatibility in teaching methods can negatively impact teaching quality and student outcomes, highlighting the need for continuous improvement in teaching skills.

The Merdeka Curriculum requires teachers to be creative and innovative in adapting their teaching methods. However, teachers accustomed to traditional methods may face challenges transitioning to this new approach. The Merdeka Curriculum demands a deep understanding of freedom-based learning methods, which can lead some teachers to rely on less effective models. This results in the perception that the Merdeka Curriculum is difficult to implement. Improving teachers' competencies requires a proper understanding of teaching methods aligned with their needs, despite challenges such as delays in literacy that necessitate effective teaching methods to enhance students' literacy skills (Irianto et al., 2020). The Merdeka Curriculum aims to improve the quality of education in Indonesia by focusing on developing student competencies and problem-based learning (Rahmah et al., 2024). The adaptation process involves changes in the curriculum, teaching methods, facilities and infrastructure, and human resource development (Fontenelle-Tereshchuk, 2021). There is the need for a transition from a cognitive-based curriculum to a competency-based curriculum and a shift from teacher-centered to student-centered teaching methods.

New curricula typically involve new teaching methods and skills that teachers need to master and teach to students (Contant et al., 2018). Important teaching methods for science education in the Merdeka Curriculum include inquiry-based learning and project-based learning. Both models have proven effective in science education. Inquiry-based learning can be supported with media developed by teachers, such as worksheets, and integrated with technological products like science simulations (Pranata, 2023a). Project-based learning can involve guiding students to create projects related to the subject, such as making posters or demonstrating concepts, and can be supported by various open-access technologies (Pranata, Sundari, et al., 2023).

The Merdeka Curriculum emphasizes creating engaging and dynamic learning experiences. In this context, the selection of teaching methods should consider various factors such as goals, students, situation, facilities, and teachers' professional capabilities (Nur, 2017). First, the method should align with learning objectives to ensure desired outcomes are achieved. Second, student characteristics, including learning styles and special needs, should be considered to ensure the method is effective for all students. Third, conditions such as class size and available time play a role in determining the appropriate method. Fourth, existing facilities and tools should support the chosen method. Finally, teachers' professional abilities, including their knowledge and skills, are crucial for successful method implementation. After considering these factors in method selection, the next step is to determine the most effective method for assessing students' understanding of the material in line with the Merdeka Curriculum principles.

5. Assessing Students' Understanding of Material According to the Merdeka Curriculum

The research findings reveal that science teachers in biology, physics, and chemistry at a high school in Sungai Penuh City and a Madrasah Aliyah (MA) in Kerinci Regency employ two primary types of assessments to evaluate students' understanding of material in line with the principles of the Merdeka Curriculum. As illustrated in Figure 5, these assessments are: first, formative assessment, which involves ongoing monitoring of students' progress through various methods, such as quizzes, observations, and evaluations of tests related to lesson material and students' descriptive abilities. This approach aims to provide constructive feedback and support an adaptive learning process. Second, summative assessment, which involves evaluating and reviewing students' exam results as a final indicator of their understanding of the material taught. By integrating both formative and summative assessments, teachers can achieve a comprehensive

view of students' learning achievements and assess the effectiveness of the teaching process within the context of the Merdeka Curriculum.

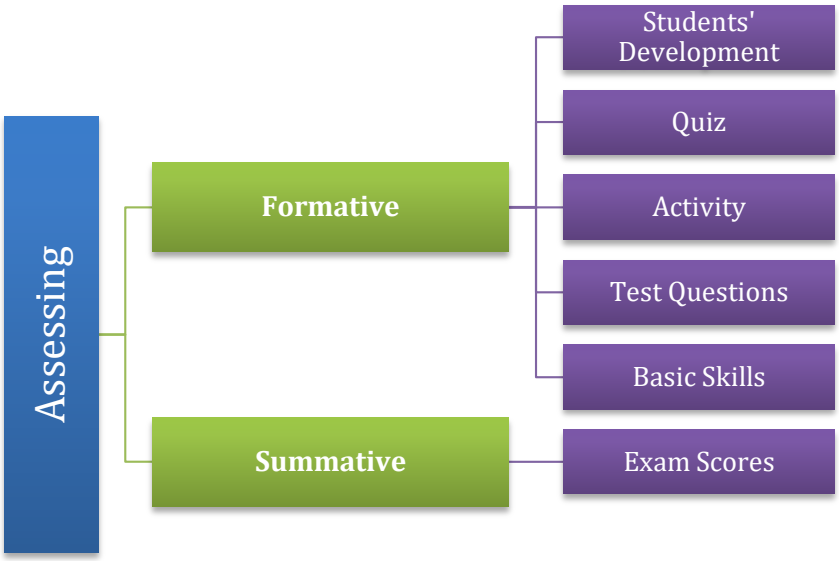

Figure 5. Assessing Students' Understanding of Material According to the Merdeka Curriculum

The study indicates that science teachers at both the high school in Sungai Penuh and the MA in Kerinci Regency apply assessment strategies that align with the Merdeka Curriculum. As shown in Figure 5, formative assessments, including quizzes, observations, and evaluations of tests and descriptive abilities, facilitate continuous monitoring of students' progress. Formative assessment is crucial for providing feedback that helps educators refine and enhance their teaching methods. According to F. Putri & Zakir (2023), formative assessment results serve not only as evaluation tools but also as a basis for improving future teaching strategies. In the context of the Merdeka Curriculum, prioritizing formative assessment enables teachers to monitor students' progress and learning needs effectively, as well as to boost their self-esteem, as noted by Wulandari (2016). Ardiansyah, et al. (2023) emphasize that formative assessment supports the design and implementation of dynamic, supportive, and meaningful learning experiences based on feedback obtained during the learning process.

In contrast, summative assessment is conducted at the end of the learning process or a specific period to evaluate the extent to which students have achieved the learning objectives according to the performance standards set by educators. Summative assessments are typically administered at the conclusion of a material unit or semester to determine the final outcomes of the learning process. Effective assessment strategies require educators to understand the fundamental differences between formative and summative assessments (Ardiansyah, et al. 2023). While formative assessment focuses on the learning process and continuous feedback, summative assessment provides a comprehensive overview of students' learning achievements over a specific period. Combining both types of assessments allows teachers to gain deeper insights into the effectiveness of the learning process and students' achievements. This integration aligns with the Merdeka Curriculum, which emphasize adaptive, student-centered learning and facilitate a comprehensive evaluation of learning outcomes.

Nationally administered achievement tests may assess information or concepts not covered in a specific school's curriculum. Concerns about these discrepancies have led to increased interest in curriculum-based assessment (CBA), which evaluates information acquired from school teachings. Curriculum-based measurement (CBM), a type of CBA, utilizes standardized procedures to derive local norms for evaluating student performance on curriculum-based tasks (Cohen & Swerdlik, 2009). In line with merdeka curriculum that providing a foundation and knowledge of Indonesian wisdom culture (Fauziah et al., 2023).

6. Integration of Technology in the Learning Process

This research reveals that out of the six teachers studied, three have integrated technology into their teaching processes, as illustrated in Figure 6. These teachers utilize tools such as projector, Canva, Quizizz, digital posters, and educational videos. The incorporation of technology has positively impacted material delivery, making it more interactive and engaging for students. Conversely, the other three teachers continue to rely on traditional teaching methods, indicating a dependence on conventional techniques. The disparity in technology use in the classroom may be influenced by factors such as technical skills, access to digital devices, and pedagogical preferences.

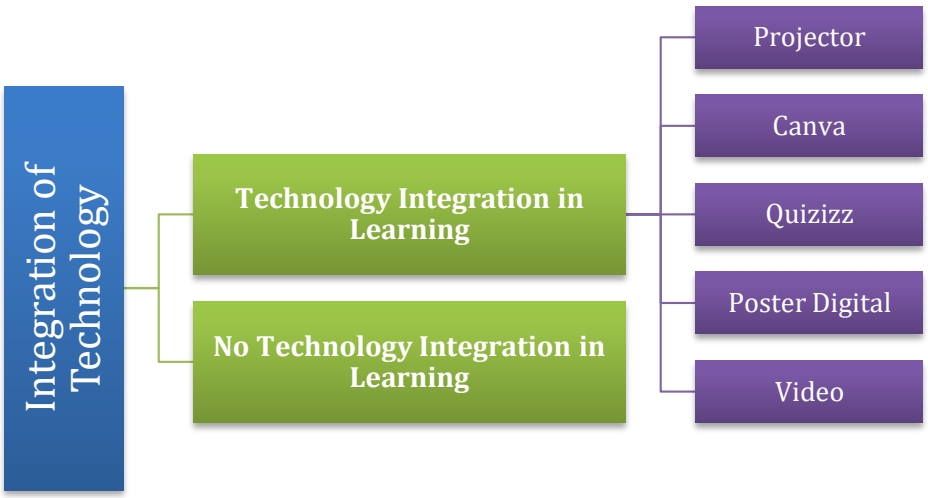

Figure 6. Integration of Technology in the Learning Process

The study highlights a notable difference in technology application among the six teachers. Data indicates that half of the teachers have effectively integrated technology tools such as projector, Canva, Quizizz, digital posters, and educational videos into their teaching processes. This integration is crucial for enhancing the effectiveness of the learning experience. Tools like projector, educational videos, and tablets have become essential in facilitating student learning activities. Technology is a key component of the Merdeka Curriculum and aligns with global trends in science education, which increasingly incorporate technological knowledge (DiGironimo, 2011). To maximize the benefits of technology, teachers need to master various applications and skills to create engaging content and maintain students' interest (Daud et al., 2019; A. L. Putri et al., 2024). Thus, technology not only supports but also significantly enriches the learning experience.

On the other hand, the three teachers who still use conventional methods reflect a reliance on traditional pedagogical approaches. This dependency is influenced by several factors: limited technical skills required for effective technology use, insufficient facilities provided by the school, and challenges in integrating technology into teaching practices. This situation highlights the need for continued efforts to implement the Merdeka Curriculum effectively, particularly with technology. To ensure the successful implementation of the Kurikulum Merdeka, both provincial and central governments need to pay serious attention to improving the quality of facilities (Jaekel et al., 2023). Challenges such as limited understanding of Learning Outcomes (LO), low teacher technology literacy, and inadequate technological skills among educators are significant barriers. Additionally, Sahin & Thompson (2007) identify teachers' readiness and capability to integrate technology into daily teaching as critical issues needing attention. In today's digital era, educators must possess technological expertise to ensure effective and high-quality learning processes (Pranata, Seprianto, et al., 2024) and assessment (Pranata, 2023b). Overall, the implementation of the Merdeka Curriculum at both the high school in Sungai Penuh City and the Madrasah Aliyah (MA) in Kerinci Regency has shown significant progress. However, challenges remain, including differences in teaching methods and a lack of facilities. To address these issues, it is essential to provide ongoing support, comprehensive training, and enhanced digital literacy for educators.

D. CONCLUSION AND SUGGESTIONS

The research on the implementation of the Merdeka Curriculum in science education at a high school in Sungai Penuh City and a Madrasah Aliyah (MA) in Kerinci Regency highlights several key findings. Most science teachers are supportive of the Merdeka Curriculum and see its potential to enhance learning outcomes, though there is variability in their readiness and adaptation to the new curriculum. Some teachers continue to rely on traditional methods, and challenges such as limited facilities, inadequate technological proficiency, and difficulties in adapting to new teaching methods persist. Students also face obstacles in transitioning to more independent and creative learning approaches. The study shows that both formative and summative assessments are used to measure students' understanding, with formative assessments being more common for providing ongoing feedback and support. The integration of technology varies among teachers, with some effectively using tools like Infocus and Quizizz, while others stick to conventional methods. The successful implementation of the Merdeka Curriculum is closely linked to the effective use of technology, which enhances interactive and engaging learning experiences.

To address these issues it is crucial to enhance professional development by offering targeted training programs. Specifically teachers would benefit from workshops on using interactive tools like Quizizz, Google Classroom, and Kahoot which can foster student engagement and understanding. Training in advanced digital literacy such as managing virtual labs or creating multimedia content for science topics would also be valuable. Professional development should emphasize hands-on, peer-supported learning methods, which allow teachers to practice and receive feedback on their technological skills and pedagogical approaches. By implementing these recommendations schools can improve student learning outcomes; for instance using tools like Google Classroom can facilitate better organization and access to resources allowing students to review materials more effectively thereby enhancing their understanding and retention of the content. Interactive platforms like Kahoot and Quizizz can increase student engagement, encouraging active participation and a deeper grasp of scientific concepts. Furthermore, the professional development of teachers and the integration of technology are mutually reinforcing. As teachers become more skilled in using educational technology they are better equipped to

create dynamic and supportive learning environments that align with the goals of the Merdeka Curriculum. This approach not only supports teachers in adapting to curriculum changes but also leads to enriched learning experiences that are more interactive and student-centered.

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