

ANALYSIS OF THE MERDEKA CURRICULUM IN MATHEMATICS EDUCATION: ITS RELEVANCE TO STUDENTS' CRITICAL THINKING SKILLS

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ABSTRACT The Merdeka Curriculum provides the foundational framework for reforms in mathematics education, emphasizing adaptability, learner-centered approaches, and the integration of real-life contexts to develop critical thinking abilities. The primary objective of this study is to examine how the Merdeka Curriculum is implemented within mathematics education and to assess its connection with students' critical thinking skills. A systematic literature review was conducted using the PRISMA methodology, encompassing the phases of identification, screening, eligibility assessment, and final inclusion of articles published between 2021 and 2026. The data, sourced from Google Scholar, were analyzed narratively to uncover implementation patterns, enabling factors, and prevailing obstacles. The findings reveal that the application of the Merdeka Curriculum in mathematics instruction primarily occurs through active learning strategies, including Project-Based Learning, Problem-Based Learning, differentiated instruction, and the utilization of contextual teaching resources such as worksheets and ethnomathematics-based modules. The results further demonstrate an enhancement in students' critical thinking capabilities, reflected in improved analytical, evaluative, inferential, and problem-solving skills. Nevertheless, successful implementation remains contingent on several factors, namely teachers' pedagogical preparedness, constraints related to instructional time, and their comprehension of the curriculum's structure. The discussion highlights that the Merdeka Curriculum holds considerable promise for fostering critical thinking, provided it is accompanied by methodical planning and consistent execution. The study concludes that while the Merdeka Curriculum is both relevant and effective in improving students' critical thinking in mathematics, it necessitates the reinforcement of teacher competencies and the refinement of classroom implementation practices.

Keywords: Critical Thinking, Mathematics Education, Merdeka Curriculum

INTRODUCTION

The Merdeka Curriculum emphasizes contextual, relevant, and flexible learning as the primary goal of educational reform, including in mathematics. Gusmawan & Herman (2023) indicate that mathematics educators continue to encounter difficulties when shifting from the 2013 Curriculum to the Merdeka Curriculum, especially in the area of designing assessments and evaluations. Hardiany (2024) also found that although the application of the Merdeka Curriculum in mathematics teaching has been relatively successful, its progress remains constrained by instructors' limited capacity to strengthen the Pancasila learner profile, as well as by restrictions on available instructional time. The findings of Manuella & Retnawati (2025) reinforce this situation, as implementation by mathematics teachers still requires support in the planning and execution stages, as well as in overcoming challenges in the classroom. In line with this, Rofik (2017) shows that inquiry-based mathematics learning on the topic of geometric solids and symmetry can improve both student motivation and learning outcomes, suggesting that learning designs that give students opportunities to discover concepts independently are more consistent with the learner-centered orientation of the Merdeka Curriculum.

Mathematics instruction should not be limited to mastering computational procedures, but should also focus on developing critical thinking skills so that students

can analyze problems, provide reasoning, evaluate information, and draw accurate conclusions. Elmawati & Juandi (2022) emphasize that mathematical critical thinking skills are part of the 4C competencies that 21st-century students need to possess, while Sari & Juandi (2023) demonstrate that the development of critical thinking in mathematics education is largely supported by active learning methods, instructional materials, and approaches that encourage students to think deeply. Therefore, mathematics serves as a strategic domain for developing critical thinking skills through targeted problem-solving activities.

A number of studies indicate that the application of the Merdeka Curriculum within mathematics education creates opportunities for improving students' critical thinking abilities, especially through the use of differentiated instruction and Project-Based Learning. Noviyanti et al. (2025) found that differentiated instruction supports the development of analytical, evaluative, inferential, and problem-solving skills; however, teachers' competencies in differentiation strategies remain a barrier. Sartika (2025) indicates that Project-Based Learning under the Merdeka Curriculum can enhance critical thinking skills, though logical reasoning and information evaluation abilities still require strengthening. Ahmad et al. (2024) as well as Rusmiati et al. (2023) also reported challenges in developing instructional modules, project planning, curriculum understanding, and instructional innovation. This pattern is consistent with Kusmawati et al. (2025) report that a Project Based Learning module can be valid, practical, and effective for improving science process skills and critical thinking, reinforcing the idea that student-centered instructional design is a key mechanism through which the Merdeka Curriculum can support higher-order thinking.

These conditions underline the need to examine how the Merdeka Curriculum is implemented in mathematics education and how it relates to students' critical thinking skills. Elmawati & Juandi (2022) highlight the importance of synthesizing research through the PRISMA protocol, as findings on mathematical critical thinking remain scattered, diverse, and not yet fully mapped. Likewise, Sari & Juandi (2023) show that many studies still focus on specific teaching techniques, indicating the value of an SLR for identifying trends, gaps, and practical implications of the Merdeka Curriculum's implementation in mathematics education. Accordingly, this SLR is expected to provide a more systematic scientific overview for teachers, researchers, and policymakers.

LITERATURE REVIEW

Merdeka Curriculum

Ardianti & Amalia (2022) and Rahmadayanti & Hartoyo (2022), state that the Merdeka Curriculum provides schools and teachers with the autonomy to design learning experiences that respond to students' needs, particularly concerning meaningful lesson planning, the selection and use of instructional materials, and the strengthening of the Pancasila Student Profile at the elementary school level. Rahayu et al. (2022) and Sumarsih et al. (2022) point out that the structure of the Merdeka Curriculum entails more than simply renaming the curriculum; it also features a more systematic arrangement of learning components, including learning outcomes, learning objectives, the sequence of learning objectives, teaching modules, and projects aimed at reinforcing the Pancasila Student Profile. Mahmud et al. (2023) emphasize that this structure serves as a framework that guides teachers in developing the operational curriculum for educational units, thereby making learning more focused, flexible, and aligned with school conditions.

During the implementation phase, Rahayu et al. (2022) and Sari & Liunokas

(2024) demonstrate that the implementation of the Merdeka Curriculum requires schools to adapt their planning, instruction, and assessment to the availability of resources, school leadership, and student characteristics. Heryanti et al. (2023) and Sumarsih et al. (2022) indicate that teachers need to understand how to translate learning outcomes into learning objectives and learning objective sequences, and then use them to design adaptive instruction while addressing challenges through reflection, training, and discussion. Mahmud et al. (2023) further stress that initiatives aimed at reinforcing the Pancasila Student Profile, along with parental collaboration, represent essential elements of curriculum implementation. These components ensure that the Merdeka Curriculum serves not only as a formal policy document but also as a driving force for transforming instructional practices within the classroom.

Mathematics Learning in the Merdeka Curriculum

Gusteti & Neviyarni (2022) and Fianingrum et al. (2023) explain that mathematics instruction within the Merdeka Curriculum is learner-centered, accommodating variations in students' abilities, interests, and learning needs. It demands an interactive and meaningful learning process focused on developing students' potential. The curriculum's implementation structure is reflected in the formulation of learning outcomes, the sequencing of learning objectives, the development of teaching modules, the adoption of student-centered approaches, and the application of problem-based learning models that encourage learners to actively solve real-world problems. Furthermore, research on blended learning-based mathematics instruction shows that the Merdeka Curriculum also permits flexibility in managing learning through the use of digital resources. In terms of numeracy literacy enhancement strategies, collaboration among teachers, schools, the government, and parents is emphasized to ensure that mathematics learning extends beyond procedural mastery toward conceptual understanding and practical application. Sadieda et al. (2022), Feriyanto (2022), and Jauzaa et al. (2024) explain that implementing the Merdeka Curriculum in mathematics education requires teachers to design flexible, adaptive, and reflective learning activities. Educators must also tailor instructional strategies and media to suit students' characteristics, ensuring that the learning process genuinely fosters greater active participation and leads to improved mathematics learning outcomes.

Critical Thinking Skills in Mathematics Education

In the context of mathematics education, critical thinking is defined as the students' capacity to recognize issues, assess information, develop reasoned arguments, choose appropriate problem-solving strategies, and reach valid conclusions. Malinda et al. (2022) indicate that when solving national science competition mathematics problems, students can demonstrate indicators of interpretation, analysis, evaluation, and inference; therefore, mathematics instruction should incorporate non-routine problems that require reasoning. Djong et al. (2024) emphasize that students' thinking processes when solving HOTS-oriented math problems are influenced by the complexity level of the problems presented, making the quality of the problems a crucial factor in fostering higher-order thinking. Amrina et al. (2024) identified a significant correlation among critical thinking, creative thinking, and problem-solving abilities in elementary school students, suggesting that critical thinking skills directly contribute to the successful resolution of mathematical problems. Estiyani et al. (2024) showed that learning interest is linked to the fulfillment of mathematical critical thinking indicators; students with a very high level of learning interest were able to achieve all indicators, whereas those with low learning interest met only a portion of them. These results are consistent with the meta-analysis conducted by

Yohannes et al. (2021), which reported an effect size of 0.970 for the impact of the problem-based learning model on junior high school students' mathematical critical thinking skills. Consequently, mathematics instruction that is contextual, problem-centered, and requires students to construct arguments serves as a powerful strategy for fostering their critical thinking abilities.

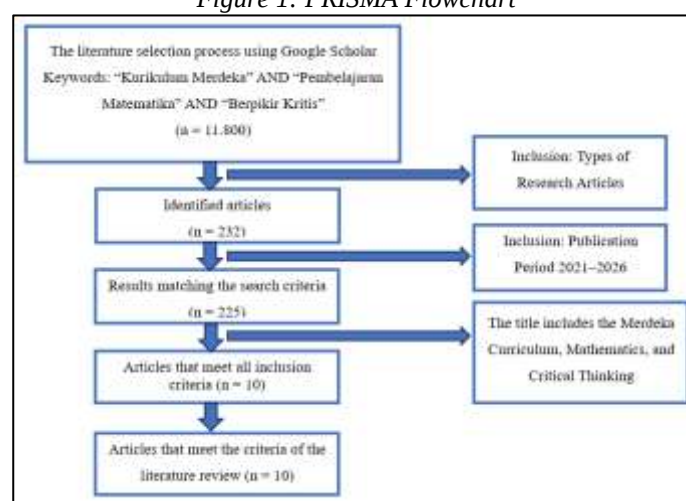
RESEARCH METHODS

This study employed a systematic literature review following the PRISMA guidelines to identify articles on the implementation of the Merdeka Curriculum in mathematics education and its relationship to students' critical thinking skills. Page et al. (2021) emphasize that PRISMA 2020 is used to enhance the clarity and completeness of systematic review reporting through the stages of identification, screening, eligibility assessment, and inclusion. Rethlefsen & Page (2021) also stress that the reporting of the selection process must be detailed to ensure that the study search can be consistently traced.

The literature search was conducted via Google Scholar using keywords derived from three main focuses: the Merdeka Curriculum, mathematics education, and critical thinking. The publication timeframe was restricted to 2021–2026 in order to reflect the current and most pertinent context of the Merdeka Curriculum's implementation. The articles selected for inclusion had to be journal publications addressing the application of the Merdeka Curriculum in mathematics education and containing information relevant to students' critical thinking skills. The article selection process was carried out in sequential stages, involving the review of titles, abstracts, and full texts, following the PRISMA guidelines, which mandate a systematic and transparent approach to screening.

Data from the selected articles were extracted into an analysis table containing the authors' names, year, research objectives, findings, forms of the Merdeka Curriculum implementation, and findings related to critical thinking. Subsequently, the data were synthesized narratively to identify patterns of implementation, supporting factors, inhibiting factors, and the relevance of the Merdeka Curriculum implementation to mathematics learning. This approach aligns with PRISMA, which emphasizes the traceability of processes, the reproducibility of steps, and clear reporting of results at all stages of a systematic review (Page et al., 2021). The following is the flowchart of the article identification process in accordance with PRISMA guidelines.

Figure 1: PRISMA Flowchart



FINDINGS AND DISCUSSION

The Merdeka Curriculum in mathematics education is the focus of a collection of articles that have met the inclusion criteria based on the results of our search and selection process. The selected articles contain information regarding implementation methods, learning contexts, and outcomes related to students' critical thinking skills. All of these articles are presented as initial data prior to further analysis to identify patterns and trends in the findings. The following table lists the articles included in the analysis.

Table1: Lists The Articles Included In The Analysis

No	Author and Year	Journal	Title	Research Results
1	A'izah & Dewi (2024)	Circle: Jurnal Pendidikan Matematika	"Efektivitas Project Based Learning dalam Kurikulum Merdeka terhadap Kemampuan Berpikir Kritis Matematis Siswa SMP Negeri 1 Karangdadap"	Project-Based Learning in the Merdeka Curriculum enhances students' mathematical critical thinking skills. High posttest scores with an N-gain of 0.765 indicate strong effectiveness.
2	Balkist et al. (2023)	AKSIOMA: Jurnal Program Studi Pendidikan Matematika	"Analisis Pengalaman Pengembangan Diri Guru Matematika Terhadap Pembelajaran Yang Berdiferensiasi Dan Mendorong Berpikir Kritis"	Differentiated instruction has a significant impact on learning that fosters critical thinking. Teachers' experience does not have a direct impact on critical thinking skills.
3	Enha & Sutarto (2024)	PRISMA, Prosiding Seminar Nasional Matematika	"Pengembangan LKPD Berbasis Kontekstual dengan Model Pembelajaran Generatif pada Kurikulum Merdeka untuk Meningkatkan Kemampuan Berpikir Kritis Matematis"	Context-based worksheets in the Merdeka Curriculum have been found to be highly effective and easy to understand. The use of these worksheets enhances students' mathematical critical thinking skills.
4	Lase et al. (2025)	JagoMIPA: Jurnal Pendidikan Matematika dan IPA	"Pengembangan Modul Ajar Kurikulum Merdeka Berbasis Etnomatematika untuk Meningkatkan Kemampuan Berpikir Kritis Siswa UPTD SMP Negeri 5 Gunungsitoli"	The ethnomathematics-based teaching module has been found to be highly valid, practical, and effective. The module is capable of enhancing students' critical thinking skills.
5	Nuraeni et al. (2023)	Jurnal Edumath	"Analisis Kemampuan Bernalar Kritis melalui Motivasi Belajar Matematika dalam Kurikulum Merdeka"	Students' critical thinking skills vary across high, medium, and low categories. Students in the high category are able to meet all critical thinking indicators.
6	Safari & Inayah (2025)	Polinomial: Jurnal Pendidikan Matematika	"Studi Literatur: Efektivitas Model Pembelajaran Matematika di Sekolah Dasar dalam Implementasi Kurikulum Merdeka"	Active learning models such as PBL, Discovery Learning, and PjBL have a positive impact on mathematics learning. These models promote the development of critical thinking and student engagement.
7	Syakroni et al. (2026)	Jurnal PEKA (Pendidikan Matematika)	"Peran Kurikulum Merdeka Dalam Meningkatkan Kemampuan Berpikir Kritis Matematis Siswa Sekolah Dasar"	The Merdeka Curriculum has the potential to enhance students' mathematical critical thinking skills. The success of its implementation depends on

				teacher competence and learning support.
8	Zulaeha et al. (2026)	JIMAT: Jurnal Ilmiah Matematika	“Pengaruh Model Problem Based Learning Terhadap Kemampuan berpikir Kritis Matematika Siswa Sekolah Dasar Dalam Kurikulum Merdeka”	Problem-Based Learning fosters higher levels of mathematical critical thinking skills compared to conventional learning. The differences in outcomes between classes were found to be significant.
9	Sartika (2025)	Edu Society: Jurnal Pendidikan, Ilmu Sosial, dan Pengabdian Kepada Masyarakat	“Analisis Kemampuan Berpikir Kritis Siswa dalam Pembelajaran Matematika Berbasis Project-Based Learning di Era Kurikulum Merdeka”	Project-Based Learning supports the development of critical thinking through problem clarification and reflection. Students' logical reasoning skills still need to be improved.
10	Khafidh & Sajiman (2025)	Jurnal Pendidikan Matematika dan Sains	“Membangun Keterampilan Berpikir Kritis Melalui Trigonometri Analitik dengan Pendekatan Kurikulum Merdeka”	Analytic trigonometry in the Merdeka Curriculum effectively develops logical and analytical thinking skills. This learning approach supports the development of students' critical thinking skills.

The findings from the article review indicate that the implementation of the Merdeka Curriculum in mathematics education is most clearly reflected through instructional approaches that promote active student engagement, including Project-Based Learning, Problem-Based Learning, differentiated instruction, contextually designed worksheets, ethnomathematics-based teaching modules, and analytical trigonometry. Rather than functioning as a standalone curricular structure, the Merdeka Curriculum appears to gain its effectiveness through pedagogical models that encourage inquiry, reflection, and problem solving. A'izah & Dewi (2024) reported an average posttest score of 86.6 with an N-gain of 0.765 in classes using Project-Based Learning, while Balkist et al. (2023) found that differentiated instruction had a significant effect on learning that fosters critical thinking, although the direct influence of teacher experience on critical thinking was not significant. In a similar vein, Enha & Sutarto (2024) showed that context-based worksheets using a generative model within the Merdeka Curriculum are feasible to use and improve mathematical critical thinking skills, with an N-gain of 0.53.

The development of instructional materials also shows a consistent pattern of quality in terms of validity, practicality, and effectiveness. Lase et al. (2025) produced an ethnomathematics-based instructional module that was highly valid, highly practical, with a practicality score of 83.72%, and highly effective, with an effectiveness score of 90.62%. Enha & Sutarto (2024) likewise reported content expert validation of 96.37%, media expert validation of 95.26%, and readability of 80.78%. Taken together, these findings suggest that instructional materials aligned with the Merdeka Curriculum can serve as effective tools for supporting students' critical thinking, particularly when they are designed to be contextual and interactive.

Student-level findings further reinforce this convergence, showing that critical thinking skills vary across learners but tend to improve when instruction is active and contextually meaningful. Nuraeni et al. (2023) identified high, moderate, and low categories of students' critical reasoning skills, with students in the high category able to

meet four indicators of critical reasoning. Safari & Inayah (2025) reported that Problem-Based Learning, Discovery Learning, Teams Games Tournament, Project-Based Learning, and Inquiry Learning have a positive and significant influence on learning outcomes and student behavior in mathematics learning. Sartika (2025) found that Project-Based Learning facilitates problem clarification and process reflection, while Khafidh & Sajiman (2025) demonstrated that analytical trigonometry effectively develops students' logical and analytical thinking skills. Collectively, these studies indicate that the effectiveness of the Merdeka Curriculum in fostering critical thinking does not stem merely from the curriculum framework itself, but from constructivist-oriented instructional practices embedded in its implementation.

Table2: Implementation Method and Findings

No	Author and Year	Implementation Method	Findings
1	A'izah dan Dewi, 2024	Project-Based Learning	The application of the Merdeka Curriculum using Project-Based Learning (PjBL) led to an enhancement in students' mathematical critical thinking abilities, recording an N-gain of 0.765 and a mean posttest score of 86.6.
2	Balkist, Dasari, dan Fitriasari, 2023	Differentiated Instruction	The implementation of differentiated instruction is linked to learning that fosters critical thinking, whereas the direct influence of teacher experience on critical thinking is not significant.
3	Enha dan Sutarto, 2024	Contextual worksheets using a generative model	Worksheets in the Merdeka Curriculum were found to be appropriate and effective for improving mathematical critical thinking, with an N-gain of 0.53.
4	Khafidh dan Sajiman, 2025	Analytic Trigonometry	Mathematics instruction on analytical trigonometry in the Merdeka Curriculum effectively develops students' logical and analytical thinking skills.
5	Lase, Mendrofa, Lase, dan Telaumbanua, 2025	Ethnomathematics-based teaching modules	The Merdeka Curriculum teaching modules were found to be highly valid, highly practical, and highly effective in improving students' critical thinking skills.
6	Nuraeni, Ermawati, dan Riswari, 2023	Critical thinking in mathematics education	Students' critical reasoning skills under the Merdeka Curriculum fall into high, moderate, and low categories, with the high category demonstrating the ability to meet four critical reasoning indicators.
7	Safari dan Inayah, 2025	PBL, Discovery Learning, TGT, PjBL, Inquiry Learning	Mathematics learning models aligned with the Merdeka Curriculum have a positive and significant impact on student learning outcomes, engagement, and critical thinking.
8	Sartika, 2025	Project-Based Learning	Problem-Based Learning (PjBL) in the Merdeka Curriculum era aids in problem clarification and reflection on the thinking process, but logical argumentation skills remain moderate.
9	Syakroni, Pratiwi, dan Farhanudin, 2026	Contextual and adaptive learning, Discovery Learning, Project-Based Learning	The Merdeka Curriculum has the potential to enhance mathematical critical thinking, but challenges persist regarding teacher understanding and ongoing professional development.
10	Zulaehe, Tutu, dan Fabanyo, 2026	Problem-Based Learning	Problem-Based Learning in the Merdeka Curriculum yields higher mathematical critical thinking skills compared to the control group, with

a significant difference.

Based on the overall analysis, a clear pattern emerges: the Merdeka Curriculum creates space for student-centered mathematics learning, yet its effectiveness depends largely on teachers' pedagogical readiness and the availability of appropriate instructional resources. Syakroni et al. (2026) note that the Merdeka Curriculum has strong potential to improve mathematical critical thinking, but this potential is constrained by limited teacher understanding and insufficient ongoing professional development. Similarly, Balkist et al. (2023) found that 38.5% of teachers had not yet implemented differentiated instruction as required by the Merdeka Curriculum. Taken together, these findings suggest that the curriculum itself is not sufficient to guarantee improved learning outcomes; rather, its impact becomes more visible when it is supported by instructional models and teaching tools that enable students to analyze, evaluate, and solve problems independently.

This emphasis on student-centered learning also shifts the teacher's role from a transmitter of content to an active facilitator of reflective and meaningful learning experiences. Gusmawan & Herman (2023) explain that successful curriculum implementation depends heavily on teachers' pedagogical readiness in designing learning experiences that are both meaningful and contextually appropriate. Rusmiati et al. (2023) further show that implementation challenges are not limited to conceptual understanding of the curriculum, but also include the ability to align instructional strategies with students' characteristics. In addition, Hardiany (2024) identifies time constraints and the reinforcement of the Pancasila learner profile as factors that continue to affect the quality of mathematics learning. These findings collectively indicate that the Merdeka Curriculum requires systematic coherence between planning, implementation, and evaluation so that learning outcomes can be achieved optimally. In this sense, strengthening mathematics instruction involves not only content delivery, but also the pedagogical processes that stimulate higher-order cognitive activity (Gusmawan & Herman, 2023; Hardiany, 2024; Rusmiati et al., 2023).

Despite the generally positive pattern reported in the literature, the implementation of the Merdeka Curriculum in mathematics education is not yet uniformly effective across schools and contexts. Several studies show that teacher readiness remains uneven, particularly in adjusting to new curriculum paradigms, assessment practices, and student-centered instructional models (Gurion & Nasir, 2024; Langoday et al., 2024). In mathematics classrooms, implementation is also constrained by students' low basic mathematical abilities, limited instructional time, and unequal digital infrastructure and laboratory access, as reported in MAN 2 Karanganyar (Nabila et al., 2026). These conditions indicate that the curriculum's contribution to critical thinking is highly dependent on school capacity, teacher competence, and implementation support, rather than on curriculum design alone. Compared with the positive findings in this review, especially those showing that Project-Based Learning, differentiated instruction, and contextual materials can improve critical thinking, the less favorable findings suggest that such benefits are not automatic and may be concentrated in settings with stronger pedagogical and infrastructural support. Because much of the available evidence is descriptive and context-specific, the literature may also overrepresent successful cases; therefore, claims about the effectiveness of the Merdeka Curriculum in fostering mathematical critical thinking should be interpreted cautiously and not generalized too broadly (Gurion & Nasir, 2024; Masjudin, 2024).

The relationship between the Merdeka Curriculum, mathematics instruction, and

critical thinking further shows that the development of critical thinking is shaped less by curriculum policy alone than by the instructional design through which the curriculum is enacted. Elmawati & Juandi (2022) state that mathematical critical thinking involves the ability to analyze, evaluate, and construct logical arguments based on learned concepts, while Sari & Juandi (2023) emphasize that active and contextual learning approaches are essential in supporting this development. Within this framework, Noviyanti et al. (2025) demonstrate that differentiated instruction can promote critical thinking by adapting learning to students' needs, whereas Ahmad et al. (2024) show that challenges in instructional planning and innovation may reduce the effectiveness of such development. Accordingly, the implementation of the Merdeka Curriculum in mathematics education is most effective when it is translated into instructional practices that encourage independent analysis, evaluation, and problem solving, because critical thinking develops through constructivist-oriented learning processes rather than through curriculum structure alone (Ahmad et al., 2024; Elmawati & Juandi, 2022; Noviyanti et al., 2025; Sari & Juandi, 2023)

CONCLUSION

The findings reveal that the Merdeka Curriculum is well-aligned with the cultivation of critical thinking skills in mathematics education. This alignment is evident through its emphasis on learner-centered instruction, adaptable teaching strategies, integration of real-world contexts, and the application of instructional models that promote analytical and reflective thinking. The curriculum's inherent design allows students to independently engage with problems, present reasoned arguments, assess information, and develop solutions using approaches such as Project-Based Learning, Problem-Based Learning, differentiated instruction, and context-based teaching materials. Nevertheless, the curriculum's potential has yet to be fully realized, as its effectiveness largely depends on teachers' preparedness, the accuracy of lesson planning, and consistent classroom implementation. Consequently, the Merdeka Curriculum not only offers a more flexible structure for mathematics instruction but also holds significant promise for strengthening students' critical thinking abilities when it is implemented systematically and appropriately.

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