Curricula: Journal of Curriculum Development *- e-ISSN 2830-7917 & p-ISSN 2964-7339*
Volume 5 No 2 (2026) 759-772

Curricula:
Journal of Curriculum Development
https://ejournal-education.upi.edu/curricula

Comparative analysis of Kurikulum Merdeka and Malaysia's KSSM in mathematical literacy

Nadya Irba Rosyadah[1], Artika Nur Noviani[2], Ika Kurniasari[3]
[1,2,3] Universitas Negeri Surabaya, Kota Surabaya, Indonesia
25030174088@mhs.unesa.ac.id[1], 25030174142@mhs.unesa.ac.id[2], ikakurniasari@unesa.ac.id[3]

ABSTRACT

Mathematical literacy is a crucial skill in the 21st century, helping people understand and apply Mathematics in everyday life. However, the results of the PISA 2022 show that Indonesia and Malaysia still have mathematical literacy skills below the OECD average. To address this issue, Indonesia began implementing the Kurikulum Merdeka in 2022, while Malaysia has been using the Kurikulum Standar Sekolah Menengah (KSSM) since 2017. This study aims to compare the two curricula for improving mathematical literacy by analyzing official documents, academic articles, and international reports. The study results show that both curricula focus on problem-solving, analytical thinking, and the application of Mathematics in real-world situations. However, the Independent Curriculum emphasizes greater freedom to improve mathematical literacy through teacher analysis, project-based learning, and a student-centered approach. On the other hand, the KSSM has a more structured learning system that incorporates Higher-Order Thinking Skills (HOTS) and a standardized numeracy program. These differences can serve as a reference for improving the quality of Mathematics education in Southeast Asia.

ARTICLE INFO

Article History:
Received: 10 Dec 2025
Revised: 8 May 2026
Accepted: 14 May 2026
Publish online: 12 Jun 2026

Keywords:
KSSM; Kurikulum Merdeka; mathematical literacy; mathematics education

Open access
Curricula: Journal of Curriculum Development is a peer-reviewed open-access journal.

ABSTRAK

Literasi Matematika sebagai keterampilan penting di abad ke-21, yang membantu masyarakat memahami dan menerapkan Matematika dalam kehidupan sehari-hari. Namun, hasil PISA 2022 menunjukkan bahwa Indonesia dan Malaysia masih memiliki keterampilan literasi Matematika di bawah rata-rata OECD. Untuk mengatasi masalah ini, Indonesia mulai menerapkan Kurikulum Merdeka pada tahun 2022, sedangkan Malaysia telah menggunakan Kurikulum Standar Sekolah Menengah (KSSM) sejak tahun 2017. Studi ini bertujuan untuk membandingkan kedua kurikulum tersebut dalam meningkatkan literasi Matematika melalui analisis dokumen resmi, artikel akademis, dan laporan internasional. Hasil studi menunjukkan bahwa kedua kurikulum tersebut berfokus pada pemecahan masalah, berpikir analitis, dan penerapan Matematika dalam situasi dunia nyata. Namun, Kurikulum Merdeka lebih menekankan kebebasan bagi guru, pembelajaran berbasis proyek, serta pendekatan yang berpusat pada siswa. Di sisi lain, KSSM memiliki sistem pembelajaran yang lebih terstruktur yang menggabungkan keterampilan berpikir tingkat tinggi (HOTS) dan program numerasi yang terstandarisasi. Perbedaan-perbedaan ini dapat dijadikan acuan untuk meningkatkan kualitas pendidikan Matematika di kawasan Asia Tenggara.

Kata Kunci: *KSSM; Kurikulum Merdeka; literasi Matematika; pendidikan Matematika*

How to cite (APA 7)
Rosyadah, N. I., Noviani, A. N., & Kurniasari, I. (2026). Comparative analysis of Kurikulum Merdeka and Malaysia's KSSM in mathematical literacy. *Curricula: Journal of Curriculum Development, 5*(2), 759-772.

Peer review
This article has been peer-reviewed through the journal's standard double-blind peer review, where both the reviewers and authors are anonymised during review.

https://doi.org/10.17509/curricula.v5i2.616

INTRODUCTION

Mathematical literacy is widely recognized as an essential competency in 21st-century education because it reflects individuals' ability to reason logically, solve contextual problems, and interpret quantitative information critically. Mathematical literacy is defined as the practical application of mathematical knowledge to real-world situations. While grasping core mathematical concepts is essential, the true value lies in a person's ability to actively deploy these skills to navigate and resolve everyday challenges (Pratama & Yelken, 2024). According to OECD in 2021, mathematical literacy also plays an important role in supporting students' future success in Mathematics and STEM-related fields (see: https://www.oecd.org/en/publications/oecd-skills-outlook-2021_0ae365b4-en.html). Mathematical literacy involves the ability to identify patterns, apply logical thinking, and solve real-world problems. The OECD, in 2023, defines mathematical literacy as the capacity to formulate, apply, and interpret Mathematics in various contexts to make informed decisions.

Furthermore, OECD categorizes mathematical literacy into four cognitive processes: reasoning, formulating, employing, and interpreting/evaluating, and four content domains: quantity, uncertainty and data, change and relationships, and space and shape (see: https://pisa2022-maths.oecd.org). Despite its importance, mathematical literacy levels in Southeast Asia remain relatively low. According to Kemendikbudristek, in 2023, Indonesia scored 366 points in Mathematics on PISA 2022, below both the OECD average of 472 and its 2018 score. Similarly, in 2023, the Ministry of Education Malaysia reported that Malaysia achieved 409 points, indicating a relatively better performance than Indonesia but still below the OECD average. These findings indicate that many students still face difficulties in solving contextual mathematical problems. Several studies suggest that mathematical literacy can be improved through approaches such as realistic Mathematics education, problem-based learning, and STEM-integrated learning (Udil et al., 2025).

In addition, curricula that emphasize meaningful mathematical tasks and critical-thinking activities contribute significantly to students' development of mathematical literacy (Maslihah et al., 2020). According to the Kemendikbudristek, Indonesia introduced the Kurikulum Merdeka in 2022, which emphasizes flexible learning, simplified curriculum structures, and project-based learning, as part of the Proyek Penguatan Profil Pelajar Pancasila (P5). The Kurikulum Merdeka is envisioned as a powerful mechanism to establish an equitable educational framework that meets global standards (Syahrir et al., 2024). Similarly, the Ministry of Education Malaysia in 2021 implemented the Kurikulum Standar Sekolah Menengah (KSSM) since 2017, focusing on inquiry-based learning, Higher-Order Thinking Skills (HOTS), as well as literacy and numeracy development. Both curricula reflect current educational trends that prioritize critical thinking, collaboration, problem solving, and competency-based learning.

Furthermore, previous studies have shown a strong relationship between mathematical literacy and critical thinking skills, highlighting the importance of curriculum frameworks that support meaningful mathematical learning (Purpura et al., 2017; Udil et al., 2025). Given the important role of curriculum in developing mathematical literacy, comparing the curriculum frameworks implemented in Indonesia and Malaysia is highly relevant. Although both curricula were developed in different socio-cultural contexts, their geographic proximity

https://doi.org/10.17509/curricula.v5i2.616

and similar educational challenges make comparative analysis important. However, research specifically examining the contribution of both curricula to mathematical literacy development remains limited. Most previous studies focus on general curriculum analysis or a single national context without emphasizing mathematical literacy dimensions as the central issue (Al Ayyubi et al., 2025; Kang & Cogan, 2022). Therefore, this study aims to analyze the conceptual framework of mathematical literacy underlying both curricula, examine the characteristics of the Kurikulum Merdeka and KSSM in supporting mathematical literacy development, and conduct a comparative analysis based on content, process, and contextual dimensions of mathematical literacy

LITERATURE REVIEW

Conceptual Framework of Mathematical Literacy in Curriculum

Since its introduction in the PISA framework in the late 1990s, the concept of mathematical literacy has continuously evolved in response to social, technological, and economic developments. The PISA assessment holds significant value because it evaluates 15-year-old students triennially, capturing them as they near the completion of mandatory schooling in most participating countries. Rather than aligning with specific school curricula, PISA evaluates how effectively students can apply their knowledge to practical, real-world scenarios and everyday challenges (Almarashdi & Jarrah, 2022). The PISA framework has progressively expanded the categorization of contexts, mathematical content, and cognitive processes involved in mathematical literacy.

According to OECD in 2023, mathematical literacy is defined as an individual's ability to use mathematical reasoning, concepts, procedures, and tools to formulate, apply, and interpret Mathematics in various real-world situations (see: https://pisa2022-maths.oecd.org). This broader definition emphasizes problem solving, contextual application, and 21st-century competencies, reflecting a more comprehensive understanding of mathematical literacy (Nabilah et al., 2026; Sahara et al., 2025). Mathematical literacy involves three main cognitive processes: formulating mathematical situations, applying mathematical concepts and procedures, and interpreting or evaluating mathematical results in real-world contexts. These processes are interconnected, with the formulation stage considered the most cognitively demanding (Alagumalai & Buchdahl, 2021).

Students often experience difficulties during the formulation stage, while reflective learners tend to approach these processes more systematically than impulsive learners (Mufidah & Sudirman, 2025). OECD further explains that these processes interact dynamically, depending on the problem context, rather than occurring linearly. This perspective is supported by studies linking mathematical literacy with executive function, flexible cognitive processing, and students' learning habits (Amland et al., 2025; Purpura et al., 2017). From a learning theory perspective, mathematical literacy aligns with the concept of mathematical proficiency presented in the influential report Adding It Up, which identifies five interconnected components: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition.

https://doi.org/10.17509/curricula.v5i2.616

Similarly, the Mathematical Competence Framework, or KOM Framework, identifies competencies such as mathematical thinking, reasoning, communication, modeling, and problem solving as essential elements of mathematical literacy development (Niss & Højgaard, 2019). Within national curricula, mathematical literacy is implemented through different approaches across countries. High-performing countries consistently integrate contextual problem-solving and mathematical reasoning into curriculum structures from the outset of learning, rather than treating them as additional components. This serves as an important reference for evaluating how the Kurikulum Merdeka and KSSM support mathematical literacy in practice (Maamin et al., 2021).

From a socio-cultural perspective, mathematical literacy is closely connected to social practices and contextual experiences, indicating that effective curricula should provide culturally relevant learning contexts. This principle is particularly relevant in Indonesia and Malaysia due to their rich cultural diversity, which can support authentic Mathematics learning experiences (Achor et al., 2020). Furthermore, recent studies emphasize that while these trends hold great promise, obstacles such as unequal resource distribution, institutional inertia, and flawed evaluation methods persist. This review analyzes international case studies and proven strategies to offer practical guidance for policymakers, teachers, and researchers aiming to boost math literacy and equip students for a highly interconnected, data-centric future (Sujatha & Vinayakan, 2022). This aspect has become increasingly important as both Indonesia and Malaysia continue to integrate technology into Mathematics education through digital transformation initiatives (Rosyiddin et al., 2023).

Characteristics of the Kurikulum Merdeka in Supporting Mathematical Literacy

The Kurikulum Merdeka, implemented in 2022, introduces a flexible and contextual learning approach that emphasizes teacher autonomy and conceptual understanding (Darussalam & Indah, 2024). Through the integration of the Profil Pelajar Pancasila, the curriculum promotes meaningful learning grounded in local contexts to develop students' creativity, critical thinking, character, and mathematical literacy (Hidayah & Sari, 2025). According to Kemdikbudristek, in 2022, compared with previous curricula, the Kurikulum Merdeka places greater emphasis on meaningful, contextual learning that connects mathematical concepts to real-world situations.

One of its distinctive features is the use of phase-based Learning Outcomes (*Capaian Pembelajaran*/CP), which support flexible and continuous learning. This approach allows students to develop mathematical understanding gradually, especially because Mathematics is cumulative and hierarchical in nature (Hidayah et al., 2025). The curriculum also emphasizes differentiated learning to accommodate students with diverse abilities and learning needs (Khaira et al., 2023). Mathematical literacy development is further strengthened through the P5, which promotes interdisciplinary project-based learning focused on authentic real-world problems (Hidayah & Sari, 2025).

https://doi.org/10.17509/curricula.v5i2.616

Through P5, students apply mathematical concepts in meaningful contexts while developing critical thinking and collaborative problem-solving skills. According to OECD in 2023, mathematical literacy involves applying mathematical concepts to real-life situations and solving authentic problems, which aligns with the objectives of P5 (see: https://pisa2022-maths.oecd.org). This approach also supports the development of critical thinking and collaborative problem-solving skills (Ndiung & Menggo, 2024). Despite its potential, the implementation of the Kurikulum Merdeka still faces challenges related to teacher readiness, limited learning resources, and inconsistent institutional support (Darussalam & Indah, 2024; Romadhon et al., 2025). Therefore, continuous teacher training and professional support are essential to optimize the development of students' mathematical literacy skills.

Characteristics of Malaysia's KSSM in Developing Mathematical Literacy

The Kurikulum Standar Sekolah Menengah (KSSM), implemented in 2017 as part of the Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025, is designed to shift the focus in learning from mastery of steps to conceptual understanding and application in real-world situations. This is a planned step to improve students' mathematical literacy skills, in line with 21st-century needs (How et al., 2021; Kumar & Hui, 2025). Philosophically, KSSM combines knowledge, skills, and values within a structured curriculum framework, including the application of HOTS, which are realized through unusual questions and require analytical, evaluative, and mathematical thinking skills as an important part of mathematical literacy.

In terms of content, KSSM organizes material into core areas such as number, algebra, geometry, and statistics and probability, while integrating contextual approaches and real-world, experiential inquiry that help students understand the importance of mathematical concepts in everyday life. This is supported by numeracy programs such as LINUS and SALIN to develop basic skills from an early age (Chew, 2018; Yusoff et al., 2025). In terms of assessment, KSSM uses the Pentaksiran Bilik Darjah (PBD) system, which emphasizes continuous formative assessment through various means such as observation and projects. However, the continued influence of national examinations such as the SPM still affects classroom practices. Therefore, aligning formative and summative assessments remains a challenge in its implementation (Yusoff et al., 2025).

Comparative Analysis of Kurikulum Merdeka and KSSM

The Kurikulum Merdeka and the KSSM share the same goal of improving students' Mathematics skills, but they have different approaches. The Kurikulum Merdeka emphasizes teachers' freedom to adapt learning to local conditions, whereas the KSSM emphasizes a clear structure and uniform standards for implementation (Maamin et al., 2021; Utami et al., 2025). These differences demonstrate how each country strives to improve the quality of Mathematics instruction in line with the characteristics of its education system. Both curricula prioritize active and context-appropriate learning methods. The Kurikulum Merdeka benefits from the P5, which directly enhances the ability to apply Mathematics in real-world situations through a project-based approach. The KSSM focuses on HOTS through investigative and

https://doi.org/10.17509/curricula.v5i2.616

problem-solving activities, providing a more structured approach to developing analytical and logical skills in mathematics (How et al., 2021; Putri et al., 2024).

In terms of assessment, the Independent Curriculum prioritizes formative and diagnostic assessments to support individualized learning. At the same time, the KSSM implements continuous assessment through the PBD while remaining tied to national exams such as the SPM. This difference indicates that Indonesia is beginning to reduce its reliance on standardized exams, while Malaysia still maintains a standardized assessment system (Yusoff et al., 2025). In terms of technology integration and educational access, the KSSM demonstrates a more structured approach, utilizing specific learning tools and numeracy intervention programs such as LINUS and SALIN. Meanwhile, the Independent Curriculum provides flexibility in the use of technology and encourages variation in learning, although it does not yet have a comprehensively planned intervention system. Therefore, each curriculum has its own advantages in improving mathematical literacy (Maamin et al., 2021).

METHODS

This study uses a qualitative document-based literature review to compare the Indonesian Kurikulum Merdeka and the Malaysian KSSM in the context of mathematical literacy development. Data were obtained from official curriculum documents, peer-reviewed journal articles, and international reports such as PISA. Data were analyzed using thematic coding to identify patterns, similarities, and differences. The analysis focused on how mathematical literacy is integrated into the curriculum structure, pedagogy, learning objectives, and assessment systems. Furthermore, the study examined how both curricula support key mathematical literacy competencies, including formulating, applying, and interpreting Mathematics. Furthermore, the study assessed the strengths, limitations, and alignment of each curriculum with international standards. Through this approach, the study provides a systematic comparative understanding of Mathematics education in both countries.

RESULTS AND DISCUSSION

Results

Table 1. Comparative Analysis of the Kurikulum Merdeka and KSSM in Mathematics Education Dimensions

No	Dimension	Kurikulum Merdeka (Indonesia)	KSSM Malaysia
1	Philosophical Foundation	Decentralization, flexibility, and teacher creativity	Standardization, consistency, and equal learning quality
2	Content Structure	Phase-based learning outcomes (flexible progression)	Standard Curriculum & Assessment Documents per grade (specific)
3	Pedagogical Approach	Project-based learning, differentiated instruction	Inquiry-based learning, HOTS, contextual learning

https://doi.org/10.17509/curricula.v5i2.616

No	Dimension	Kurikulum Merdeka (Indonesia)	KSSM Malaysia
4	Assessment System	Diagnostic, formative assessment, portfolio-based learning	Classroom Assessment (PBD), UPSR/SPM-oriented structure
5	Technology Integration	General use of technology, no specific standardized platform	Specific integration (e.g., GeoGebra, Desmos within curriculum standards)
6	Numeracy Intervention	Differentiated learning, non-systematic intervention	Structured programs (LINUS/SALIN)
7	Real-Life Context	Cross-disciplinary projects (P5)	Contextual HOTS problems in textbooks and examinations
8	PISA Achievement	366 points (PISA 2022)	409 points (PISA 2022)

Source: Adapted from Kemdikbudristek (2022), Ministry of Education Malaysia (2018, 2021), OECD (2023)

Table 1 provides a comparative analysis between the Kurikulum Merdeka (Indonesia) and the Malaysian KSSM about important aspects of Mathematics education, including philosophical orientation, content structure, teaching approach, assessment system, technology integration, numeracy intervention, contextual learning orientation, and student achievement in PISA 2022. The results indicate that both curricula aim to improve students' mathematical literacy. However, there are striking differences in their implementation philosophies and instructional designs.

Curriculum Philosophy and Structural Orientation

The Kurikulum Merdeka is based on a decentralized and adaptive educational philosophy, emphasizing teacher freedom, contextual learning, and the ability to customize instructional design. This approach allows teachers to tailor learning paths to student needs and local contexts (Darussalam & Indah, 2024). In contrast, the Malaysian KSSM is based on a centralized standardization framework that prioritizes consistency, equity, and uniform learning outcomes across schools. This fundamental difference reflects two distinct curriculum governance models in Southeast Asia: Indonesia adopts a flexible, competency-oriented model, while Malaysia maintains a structured, standards-based model to ensure national educational alignment (Utami et al., 2025).

Pedagogical Approach and Mathematical Literacy Development

Both curricula incorporate HOTS as an important pedagogical principle. The Kurikulum Merdeka implements HOTS through project-based learning, which encourages students to engage in contextual and interdisciplinary problem-solving activities. This approach aligns with constructivist learning theory, where knowledge is actively developed through experience (Ndiung & Menggo, 2024). In contrast, KSSM integrates HOTS more explicitly into structured inquiry-based learning and assessment tasks, supporting more systematic cognitive skill development (How et al., 2021). OECD in 2023 emphasizes that mathematical

https://doi.org/10.17509/curricula.v5i2.616

literacy involves the ability to formulate, employ, and interpret Mathematics in real-world contexts (see: https://pisa2022-maths.oecd.org). Viewed from this perspective, both curricula support the development of mathematical literacy: the Kurikulum Merdeka emphasizes contextual learning, whereas KSSM provides greater structural consistency in skill development.

Assessment System and Learning Accountability

Kemdikbudristek emphasizes that a striking difference between the two curricula is evident in assessment practices. The Kurikulum Merdeka emphasizes formative, diagnostic, and portfolio-based assessments to support individualized learning pathways. This reflects a shift from exam-focused evaluation to competency-based assessment (Ardiansah et al., 2022). On the other hand, the KSSM implements Classroom Assessment (PBD) in addition to high-consequence national exams such as the SPM. In Malaysia, while the Ministry of Education supports continuous assessment, the presence of centralized exams still influences teaching practices. This dual system creates a balance between formative learning and accountability-driven evaluation (Yusoff et al., 2025).

Technology Integration and Intervention Systems

In terms of technology integration, the KSSM demonstrates a more structured implementation through the use of standardized digital tools such as GeoGebra and Desmos, as well as numeracy intervention programs such as LINUS and SALIN (Chew, 2018). These interventions aim to strengthen basic Mathematics skills systematically. In contrast, the Kurikulum Merdeka offers greater flexibility in technology implementation without a standardized national platform. While this encourages innovation at the school level, it may also lead to differences in implementation quality across regions (Darussalam & Indah, 2024).

Contextual Learning and Real-World Application

Both curricula emphasize context-oriented learning, but in different ways. The Independent Curriculum incorporates interdisciplinary learning through the P5 framework, which allows students to apply mathematical concepts in real-world and cross-disciplinary contexts (Hidayah & Sari, 2025; Ndiung & Menggo, 2024). In contrast, the KSSM integrates real-world applications through contextual HOTS problems embedded in textbooks and national examinations (Kumar & Hui, 2025). Both approaches reflect a shared commitment to meaningful Mathematics learning, yet differ in their structural implementation and degree of flexibility.

Comparative Outcomes and PISA Performance

According to an OECD report in 2023, Malaysia achieved an average score of 409 in PISA 2022, while Indonesia scored 366, with both countries remaining below the OECD average of 472 (see: https://pisa2022-maths.oecd.org). Malaysia's relatively higher performance

https://doi.org/10.17509/curricula.v5i2.616

may be associated with its structured curriculum framework and systematic numeracy interventions, which support more consistent learning outcomes across schools (Chew, 2018; How et al., 2021; Maamin et al., 2021). Meanwhile, Indonesia's ongoing curriculum reform through the Kurikulum Merdeka reflects a long-term strategy to improve conceptual understanding and problem-solving skills in context, which may contribute to improved mathematical literacy outcomes in the future (Hidayah & Sari, 2025).

Synthesis of Findings

In 2023, OECD reported that Malaysia achieved an average Mathematics score of 409 in PISA 2022, while Indonesia scored 366, with both countries remaining below the OECD average of 472 (see: https://pisa2022-maths.oecd.org). Malaysia's relatively higher performance may be associated with its structured curriculum framework, systematic integration of HOTS, and numeracy intervention programs such as LINUS, which support more consistent learning experiences across schools (Chew, 2018; How et al., 2021; Maamin et al., 2021). Meanwhile, Indonesia's ongoing curriculum reform through the Kurikulum Merdeka reflects a long-term effort to strengthen conceptual understanding, contextual learning, and problem-solving skills, which may contribute to improved mathematical literacy outcomes in the future (Hidayah & Sari, 2025).

Implications for Curriculum Development

The findings suggest that an ideal curriculum for developing mathematical literacy must balance flexibility and standards. Teachers' professional competence is a crucial factor in both systems, particularly in designing tasks that encourage thinking skills and real-world applications. Furthermore, stronger integration between digital literacy and real-world problem-solving contexts is essential to align Mathematics education with the demands of 21st-century skills. A hybrid model that combines structured interventions (such as those in the KSSM) with contextual flexibility (such as those in the Independent Curriculum) could offer a more balanced approach to improving mathematical literacy outcomes in Southeast Asia.

Discussion

This study reveals systematic and meaningful differences between Indonesia's Kurikulum Merdeka and Malaysia's KSSM in their approaches to developing students' mathematical literacy. These differences are evident across curriculum governance, pedagogical design, assessment orientation, and implementation consistency, all of which collectively shape how students engage with mathematical thinking in classroom practice. The Kurikulum Merdeka is characterized by a decentralized, flexible design that emphasizes contextual, student-centered learning through project-based learning. This structure aligns closely with Realistic Mathematics Education, in which mathematical concepts are constructed through engagement with real-world contexts. Previous studies have demonstrated that such an approach strengthens students' ability to reason, model, and solve contextual problems, thereby enhancing mathematical literacy (Ndiung & Menggo, 2024; Putri et al., 2024).

https://doi.org/10.17509/curricula.v5i2.616

However, the effectiveness of this approach is not guaranteed by curriculum design alone. Its success is highly contingent upon teachers' pedagogical competence and institutional support systems, which remain uneven across regions (Darussalam & Indah, 2024; Romadhon et al., 2025). This variability creates disparities in implementation quality, which may limit the curriculum's overall impact on national learning outcomes. In contrast, the KSSM operates within a more centralized and standardized framework that ensures uniformity in curriculum delivery and learning expectations across schools. The structured integration of HOTS, combined with systematic numeracy intervention programs such as LINUS, promotes consistent cognitive skill development among students (Chew, 2018; How et al., 2021). These mechanisms provide early and continuous support for foundational mathematical competencies, which are critical for progression to more complex reasoning tasks. This structured alignment between curriculum content, pedagogy, and intervention systems may partially explain Malaysia's relatively higher performance in PISA 2022 compared to Indonesia (Maamin et al., 2021).

Despite their different structural orientations, both curricula face a similar challenge in balancing formative and summative assessment practices. The Kurikulum Merdeka prioritizes formative and diagnostic assessment intended to support learning progression, yet its implementation is still developing in many schools. Meanwhile, although the KSSM incorporates classroom-based assessment (PBD), the continued influence of high-stakes examinations such as the SPM tends to shape instructional practices toward exam-oriented learning (Yusoff et al., 2025). This tension between formative intentions and summative pressures may constrain the extent to which mathematical literacy is developed, particularly in reasoning, interpretation, and problem-solving competencies.

Another critical issue identified in both systems is the underutilization of culturally responsive and ethnoMathematics-based instruction. Empirical evidence suggests that embedding Mathematics within culturally meaningful contexts enhances student engagement and deepens conceptual understanding (Achor et al., 2020; Hartoyo et al., 2025). However, both curricula still largely treat contextualization in a general, rather than culturally grounded, manner, thereby missing an opportunity to strengthen the authenticity of mathematical learning experiences. From a cognitive perspective, the development of mathematical literacy is strongly influenced by executive functioning and reasoning processes, which are activated through structured exposure to HOTS-oriented tasks and problem-solving activities (Amland et al., 2025; Purpura et al., 2017).

This suggests that differences in student outcomes are not solely attributable to curriculum structure, but also to the extent to which classroom practices successfully engage students in cognitively demanding mathematical thinking. In this sense, curriculum effectiveness is mediated by instructional quality and cognitive activation in learning environments. Overall, the findings indicate that neither curriculum is fully sufficient in isolation. The Kurikulum Merdeka offers strong advantages in contextual flexibility and pedagogical innovation, while the KSSM provides greater coherence, structure, and system-wide consistency in skill development. A synthesis of both approaches suggests that an optimal curriculum model would integrate a structured progression of HOTS and systematic numeracy support with contextual, student-centered learning opportunities. Such a hybrid approach may provide a more balanced and effective pathway for strengthening mathematical literacy across diverse educational contexts in Southeast Asia.

https://doi.org/10.17509/curricula.v5i2.616

CONCLUSION

This study concludes that the Kurikulum Merdeka (Indonesia) and the Malaysian KSSM both support the development of students' mathematical literacy, but through different instructional and structural approaches. The Kurikulum Merdeka emphasizes flexibility, contextual learning, and student-centered pedagogy through project-based learning. At the same time, KSSM provides a more structured and centralized framework with systematic integration of HOTS and numeracy intervention programs such as LINUS. Although both curricula align with the OECD framework of mathematical literacy, differences in implementation consistency, teacher readiness, and assessment orientation contribute to variations in learning outcomes, with Malaysia showing relatively higher PISA 2022 performance than Indonesia. However, both systems still face limitations in fully optimizing mathematical literacy development, particularly in culturally responsive learning and balanced assessment practices. Therefore, a hybrid approach that integrates the contextual flexibility of the Kurikulum Merdeka with the structural coherence and systematic skill development of KSSM is recommended to enhance mathematical literacy outcomes in both countries.

AUTHOR'S NOTE

The author declares that there is no conflict of interest in the publication of this article. He also confirms that all data, analysis, and content have been compiled entirely and without plagiarism. He would like to express his gratitude to all those who have assisted, directly or indirectly, in the preparation and completion of this research.

REFERENCES

Achor, E. E., Imoko, B. I., & Uloko, E. S. (2020). Effect of ethnoMathematics teaching approach on senior secondary students' achievement and retention in locus. *Educational Research and Reviews*, *4*(8), 385-390.

Al Ayyubi, I. I., Mulyono, M., & Dewi, N. R. (2025). Studi komparatif Kurikulum Matematika di Indonesia dan Malaysia berdasarkan framework TIMSS. *Jurnal Pendidikan Matematika*, *8*(1), 43-52.

Alagumalai, S., & Buchdahl, N. (2021). PISA 2012: Examining the influence of prior knowledge, time-on-task, school-level effects on achievements in mathematical literacy processes-Interpret, employ and formulate. *Australian Journal of Education*, *65*(2), 173-194.

Almarashdi, H. S., & Jarrah, A. M. (2022). The impact of a proposed Mathematics enrichment program on UAE students' mathematical literacy based on the PISA framework. *Sustainability*, *14*(1), 1-13.

https://doi.org/10.17509/curricula.v5i2.616

Amland, T., Grande, G., Scherer, R., Lervåg, A., & Melby-Lervåg, M. (2025). Cognitive factors underlying mathematical skills: A systematic review and meta-analysis. *Psychological Bulletin*, *151*(1), 88-129.

Ardiansah, A., Komara, D. A., & Halimah, L. (2022). Evaluation of the library management program as a learning resources with discrepancy model. *Curricula: Journal of Curriculum Development*, *1*(1), 87-100.

Chew, F. P. (2018). Evaluation of the literacy and numeracy screening program in three types of national primary schools in Malaysia. *Journal of Contemporary Educational Research*, *5*(2), 9-20.

Darussalam, G. M., & Indah, R. N. (2024). Challenges and benefits teachers on the implementation of the Curriculum Merdeka: A systematic literature review. *ELLITE: Journal of English Language, Literature, and Teaching*, *9*(1), 34-44.

Hartoyo, A., Fitriawan, D., Siregar, N., & Putra, F. G. (2025). Connecting cultural roots with mathematical thinking: A comprehensive meta-analysis of ethnoMathematics practices in Indonesian classrooms. *Al-Jabar: Jurnal Pendidikan Matematika*, *16*(2), 673-689.

Hidayah, I. R., Sa'dijah, C., Anwar, L., Yerizon, Y., & Arnawa, I. M. (2025). Empowering students' numeracy skills: Mathematics teachers' perceptions regarding the effectiveness and challenges of Indonesian national curriculum and the programs-A mixed method study. *Infinity Journal*, *14*(1), 163-188.

Hidayah, R. Y., & Sari, D. I. (2025). The influence of the pancasila student profile strengthening project in Mathematics learning on the merdeka curriculum on students' problem-solving skills. *Journal of Practice Learning and Educational Development*, *5*(3), 684-692.

How, R. P. T. K., Zulnaidi, H., & Rahim, S. S. A. (2021). Analisis keperluan terhadap pembinaan modul pengajaran kemahiran berfikir aras tinggi dan kemahiran literasi digital bagi tajuk persamaan kuadratik. *JuKu: Jurnal Kurikulum & Pengajaran Asia Pasifik*, *9*(4), 15-31.

Kang, H., & Cogan, L. (2022). The differential role of socioeconomic status in the relationship between curriculum-based Mathematics and Mathematics literacy: The link between TIMSS and PISA. *International Journal of Science and Mathematics Education*, *20*(1), 133-148.

Khaira, H. S., Al Hafizh, M. F., Darmansyah, P. S. A., Nugraha, H., & Komara, D. A. (2023). Analysis of needs and teachers' perception towards business teaching materials at SMA Labschool UPI. *Curricula: Journal of Curriculum Development*, *2*(2), 299-314.

Kumar, D., & Hui, F. (2025). Development and usability of "From Formulas to A+" SPM Mathematics Comprehensive Module among upper secondary school students. *International Journal of Research*, *8*(1), 1327-1341.

https://doi.org/10.17509/curricula.v5i2.616

Maamin, M., Maat, S. M., & Iksan, Z. H. (2021). Analysis of the factors that influence Mathematics achievement in the Asean Countries. *Cypriot Journal of Educational Sciences*, *16*(1), 371-389.

Maslihah, S., Waluya, S. B., Rochmad, & Suyitno, A. (2020). The role of mathematical literacy to improve high order thinking skills. *Journal of Physics: Conference Series*, *1539*(1), 1-6.

Mufidah, S., & Sudirman, M. M. (2025). Investigating students' mathematical literacy performance in PISA questions: Information processing theory. *TPM-Testing, Psychometrics, Methodology in Applied Psychology*, *32*(S8), 207-217.

Nabilah, A., Istiqomah, M., & Handoko, H. (2026). Analysis of junior high school students' mathematical literacy processes (formulating, employing, and interpreting) in PISA space and shape. *Noumerico: Journal of Technology in Mathematics Education*, *4*(1), 68-82.

Ndiung, S., & Menggo, S. (2024). Project-based learning in fostering creative thinking and mathematical problem-solving skills: Evidence from primary education in Indonesia. *International Journal of Learning, Teaching and Educational Research*, *23*(8), 289-308.

Niss, M., & Højgaard, T. (2019). Mathematical competencies revisited. *Educational Studies in Mathematics*, *102*(1), 9-28.

Pratama, R. A., & Yelken, T. Y. (2024). Effectiveness of ethnoMathematics-based learning on students' mathematical literacy: a meta-analysis study. *Discover Education*, *3*(1), 1-15.

Purpura, D. J., Schmitt, S. A., & Ganley, C. M. (2017). Foundations of Mathematics and literacy: The role of executive functioning components. *Journal of Experimental Child Psychology*, *153(1)*, 15-34.

Putri, A. D., Juandi, D., & Turmudi, T. (2024). Realistic Mathematics education and mathematical literacy: a meta-analysis conducted on studies in Indonesia. *Journal of Education and Learning (EduLearn)*, *18*(4), 1468-1476.

Romadhon, D. R., Rosyada, D., Murodi, M., Wahdi, W., Asmu'i, A. I., & Mani, S. (2025). Balancing flexibility and challenges: Teachers' perspectives on implementing the Merdeka curriculum in science education. *Towards Resilient Societies: The Synergy of Religion, Education, Health, Science, and Technology, 1(1)*, 386-391.

Rosyiddin, A. A. Z., Fiqih, A., Nugraha, H., Hadiapurwa, A., & Komara, D. A. (2023). The effect of interactive PowerPoint media design on student learning interests. *Edcomtech: Jurnal Kajian Teknologi Pendidikan*, *8*(1), 12-24.

Sahara, S., Suryadi, D., Tarmudi, T., & Dasari, D. (2025). Ecological dimension of fraction arithmetic activities within two neighbouring countries: Study on textbooks and reference model. *Indonesian Journal of Science and Mathematics Education*, *8*(2), 284-300.

https://doi.org/10.17509/curricula.v5i2.616

Sujatha, S., & Vinayakan, K. (2022). Mathematical literacy for the future: a review of emerging curriculum and instructional trends. *International Journal of Applied and Advanced Scientific Research*, *7*(2), 65-71.

Syahrir, S., Pujiriyanto, P., Musdalifa, M., & Fitri, S. (2024). The implementation of merdeka curriculum to realize Indonesia golden generation: A systematic literature review. *Al-Ishlah: Jurnal Pendidikan*, *16*(2), 1434-1450.

Udil, P. A., Dasari, D., & Nurlaelah, E. (2025). Pedagogical interventions for enhancing students' mathematical literacy: A systematic literature review. *Pedagogika*, *158*(2), 29-59.

Utami, N. S., Prabawanto, S., Yen, P. S., & Rambee, A. R. A. (2025). The reconstruction of functions using didactic transposition: A focus on the textbooks following the Malaysian and Indonesian Mathematics curricula. *Malaysian Journal of Learning and Instruction*, *22*(2), 184-209.

Yusoff, S. M., Marzaini, A. F. M., Zakaria, N., & Lijie, H. (2025). Exploring the implementation of classroom-based assessment in Malaysian secondary schools: Alignment with policy and teacher practices. *MOJEM: Malaysian Online Journal of Educational Management*, *13*(1), 81-101.

https://doi.org/10.17509/curricula.v5i2.616