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Indonesia's Curriculum Policy Transformation in the Face of Global Disruption: An Integrative Literature Review

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Abstract
Digital disruption, artificial intelligence (AI), and shifting competency demands require Indonesian curriculum policy to remain adaptive without sacrificing policy stability. This study analyzes the transformation of curriculum policy, linking it to national and international learning-achievement evidence, and identifies implementation gaps and policy priorities. This integrative literature review synthesizes 23 scientific articles published in 2022–2025 and seven fully accessible official documents/data, including curriculum regulations, the Rapor Pendidikan Indonesia 2025, and PISA 2022. Sources were selected based on relevance, credibility, full-text accessibility, and traceability, then coded thematically and triangulated with official evidence. The findings show continuity from the flexibility of Kurikulum Merdeka toward Deep Learning as well as Coding and Artificial Intelligence. National indicators improved, including the minimum numeracy competency of primary school students from 39.04% in 2022 to 52.48% in 2024, while PISA 2022 scores remained low, at 366 in mathematics, 359 in reading, and 383 in science. Teacher readiness, uneven professional development, digital infrastructure, regional capacity, and implementation governance remain critical constraints. This review contributes a three-layer analytical framework linking regulatory change, system performance, and implementation capacity to guide evidence-based curriculum evaluation and equitable policy interventions.

Keywords: *artificial intelligence; curriculum policy; Deep Learning; global disruption; Kurikulum Merdeka*

INTRODUCTION

Changes in digital technology, artificial intelligence, work patterns, and the information ecosystem are also changing the competencies students need. Education systems can no longer merely emphasize content mastery; they must also develop the ability to understand problems, apply knowledge in new contexts, reason, collaborate, create, and use technology responsibly. This orientation is in line with the need to strengthen communication, creativity, critical thinking, and collaboration skills in 21st-century learning (Jufriadi et al., 2022). In this context, curriculum becomes a policy instrument that connects national education goals with classroom learning experiences. Curriculum needs the capacity to adapt to change while still providing stability so that teachers and educational units have enough time to translate policy into consistent learning practice (Puspitasari, 2025; Sihombing et al., 2024).

The urgency of this transformation is evident in Indonesia's learning outcomes. PISA 2022 showed Indonesia's score at 366 in mathematics, 359 in reading, and 383 in science. The OECD noted that this achievement declined compared to 2018 and was among Indonesia's lowest results since participating in PISA. The proportion of students reaching at least Level 2 was also only about 18% in mathematics, 25% in reading, and 34% in science. Because PISA assesses students' ability to apply knowledge to real-life situations, these results indicate that strengthening reasoning ability and knowledge application remains an important need in Indonesian education (OECD, 2023). National data show a more dynamic development. The Rapor Pendidikan Indonesia 2025 shows that the

proportion of SD/MI (primary school) students reaching the minimum numeracy competency increased from 39.04% in 2022 to 45.34% in 2023 and 52.48% in 2024. At the SMP/MTs (junior secondary) level, literacy achievement increased from 61.40% to 64.66% and 66.75% over the same period. The quality of SD/MI learning in the Good category also increased from 41.60% in 2022 to 53.75% in 2024. These improvements indicate positive development, but cannot be directly attributed to a single curriculum policy because education outcomes are influenced by many factors. The data are more appropriately used to provide a picture of the needs and direction for improving education policy (I. Pratiwi et al., 2025).

At the policy level, Peraturan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 12 Tahun 2024 provides the formal foundation for the curriculum in early childhood, primary, and secondary education (Permendikbudristek, 2024). The government subsequently issued Peraturan Menteri Pendidikan Dasar dan Menengah Nomor 13 Tahun 2025 as an amendment to that regulation (Kementerian Pendidikan Dasar dan Menengah, 2025b). This adjustment strengthens the Deep Learning approach and opens Coding and Artificial Intelligence as an elective subject according to the readiness of the educational unit. Guidelines for implementing Coding and Artificial Intelligence were subsequently established through Keputusan Menteri Pendidikan Dasar dan Menengah Nomor 127/P/2025 (Kementerian Pendidikan Dasar dan Menengah, 2025a). This series of policies shows the government's effort to respond to technological development without replacing the entire curriculum framework.

Literature on Kurikulum Merdeka has developed fairly extensively, but most research still focuses on teacher readiness, comparisons with Kurikulum 2013, or experiences in the early stages of implementation. Three issues that frequently arise at the primary school level are teachers' incomplete understanding, limited competence in implementation, and inadequate facilities and infrastructure (Kurniawan et al., 2024). Sephiawardani dan Bektiningsih (2023) and Priatmoko *et al.* (2024) also show that teacher readiness is one important factor in the success of curriculum implementation. In the context of 3T (frontier, outermost, and disadvantaged) regions, Lase (2024) found that limited resources make the implementation process more complex. Meanwhile, Alhapip *et al.* (2024) highlighted issues of local government coordination, differing policy interpretations, and underoptimized use of digital systems.

Policy developments in 2025 present new challenges. Deep Learning as well as Coding and Artificial Intelligence began to gain a clearer position in curriculum policy even as issues of learning-achievement gaps, teacher readiness, and infrastructure remained unresolved. Rahmawati *et al.* (2025) describes Deep Learning as an approach that emphasizes a mindful, meaningful, and joyful learning process. Ambarita et al. (2025) and Nurhasanah *et al.* (2025) show that its implementation requires institutional readiness, teacher professional development, an assessment system that supports understanding, and adequate infrastructure. On the other hand, the Coding and Artificial Intelligence policy demands technological literacy alongside an understanding of ethics, bias, data privacy, copyright, and the limitations of artificial-intelligence output (Astuti et al., 2025).

These findings show that curriculum transformation cannot be assessed from regulatory change alone. Puspitasari (2025) positions the adaptive curriculum as a means of developing critical thinking, creativity, collaboration, and digital literacy skills. Sihombing *et al.* (2024) show that technology-based education transformation requires a system that connects the use of technology with learning quality and education resilience. Mustofiyah et al. (2024) and Subagyo et al. (2024) also show that STEM and technology integration can broaden learning experiences, but its success depends on learning design, teacher capacity, and school support. Therefore, curriculum policy needs to be understood as part of an education ecosystem that includes regulation, teacher capacity, school readiness, infrastructure, and governance.

Based on these conditions, there is a need to examine curriculum transformation more comprehensively. Previous studies have tended to discuss regulatory change, learning achievement, and implementation issues separately. The novelty of this article lies in combining three layers of evidence: curriculum regulatory change in 2024–2025, education system achievement based on Rapor Pendidikan and PISA, and implementation evidence from recent research on teacher readiness, digitalization, 3T regions, Deep Learning, and artificial intelligence. This approach allows policy to be assessed not only on the relevance of its concept, but also on its alignment with education outcomes and implementation capacity in the field. Based on this framework, this study answers four questions. First, what is the direction of Indonesia's curriculum policy transformation in 2024–2025 in responding to global disruption? Second, to what extent does this policy direction align with national

and international learning-achievement evidence? Third, what implementation factors appear most consistently in the literature? Fourth, what policy priorities are needed to strengthen the relevance, capacity, equity, and governance of the curriculum? Thus, this article's contribution is to present an analytical framework that links regulatory change, education system achievement, and implementation capacity as a basis for evaluating the direction of Indonesia's curriculum policy transformation.

METHOD

This study uses an integrative literature review. This approach was chosen because the research questions require a synthesis of empirical evidence, review studies, regulations, and education system data, rather than an estimate of the effect of a single homogeneous intervention. The search for scientific articles was limited to publications from 2022–2025, while the search for policy documents was updated through August 2026 to ensure the latest regulatory changes remained covered, via GARUDA, DOAJ, and Google Scholar as discovery engines, publisher journal portals, and official government repositories. For data and policy, searches were conducted on the websites of the Ministry of Primary and Secondary Education, the Center for Education Standards and Policy, Badan Pusat Statistik (2025), and the OECD.

The main corpus consists of 23 scientific articles published in 2022–2025 and seven official documents/data, so that 76.7% of the main source list is scientific articles from the last five years. Analysis was conducted in four stages. First, mapping the chronology and content of the 2024–2025 curriculum policy. Second, extracting education-achievement indicators to identify problems that the policy needs to address. Third, thematically coding the literature into five themes: policy relevance and direction, pedagogical transformation, teacher readiness, technology and AI, and equity/governance. Fourth, triangulating findings from scientific articles with official data. The article does not interpret changes in indicators as the causal impact of Kurikulum Merdeka, because the secondary-data design used does not allow such attribution.

Scientific sources were searched through Google Scholar, Garuda/SINTA, and publisher journal portals using the same combination of keywords. Searches were also conducted through backward searching of the reference lists of the most relevant articles. Official documents were searched through government regulation portals, the Kemendikdasmen repository, the Center for Education Standards and Policy, BPS, and the OECD. Statistik Pendidikan 2025 was used as a source for checking the education system context, while Rapor Pendidikan Indonesia 2025 and PISA 2022 were used as the main outcome indicator sources. The search for policy documents was updated through August 2026 so that relevant recent policy changes remained covered. Triangulation was carried out by comparing literature findings against regulations and official data. When national and international data used different instruments, both were treated as complementary evidence and not compared directly on the same scale.

The analysis uses thematic synthesis logic and policy gap analysis. In the first stage, regulatory change was mapped to identify continuities and shifts in direction. The second stage compared the direction of policy with education system needs indicators. The third stage mapped recurring implementation barriers found in the research. The fourth stage compiled intervention priorities based on the relationship between problems, evidence, and monitoring indicators. This approach was not used to estimate the effect size of Kurikulum Merdeka, Deep Learning, or Coding-AI. Because the studies reviewed are secondary and heterogeneous, interpretation is limited to patterns, consistency of findings, and policy implications. Thematic synthesis — policy direction, learning achievement, pedagogy, teacher capacity, and digital equity — can be seen in the figure below.

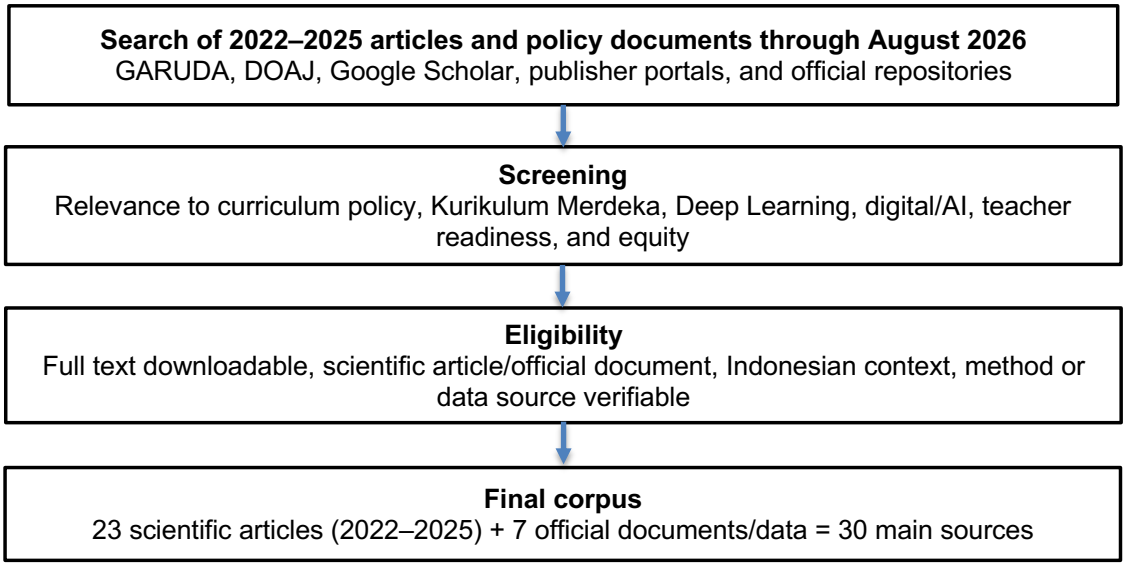


Figure 1. Source selection and synthesis framework.

RESULTS AND DISCUSSION

Policy synthesis shows continuity, not disruption, between Kurikulum Merdeka and the 2025 adjustment. The 2024 regulation provides a formal structure emphasizing flexibility and competency-based learning. The 2025 change adds a pedagogical emphasis through Deep Learning and a technological response through Coding and Artificial Intelligence. This pattern is more accurately understood as incremental adaptation. Its advantage is that schools do not need to repeat a total curriculum transition process, so implementation energy can be directed toward the quality of classroom practice.

This direction is consistent with the findings of Pratiwi *et al.* (2024) that Kurikulum Merdeka gives greater room for flexible, project-based, character-oriented learning attentive to student needs compared to Kurikulum 2013. Dirgantoro and Soesanto (2023) show that pre-service teachers generally have a positive initial readiness toward Kurikulum Merdeka, although some still need a deeper understanding. Thus, policy flexibility needs to be accompanied by sufficient support structure so that autonomy does not turn into overly wide quality variation.

Deep Learning clarifies this orientation. Rahmawati *et al.* (2025) formulate mindful, meaningful, and joyful learning through learning experiences of understanding, applying, and reflecting. Ambarita et al. (2025) emphasize a shift from rote memorization toward understanding, problem-solving, creativity, and self-reflection. Nurhasanah *et al.* (2025), through a systematic literature review of 31 articles, found that project-based, inquiry-based, and reflective learning are widely used to foster deep cognitive engagement, but their success depends on policy support, professional development, assessment, and infrastructure.

Coding and AI add a new dimension to the curriculum. The 2025 official guideline does not limit AI to software use, but also includes ethics, bias, personal-data protection, output hallucination, copyright, transparency, dependency, and sustainability. This approach is important because AI competency must include the ability to critique technology, not just operate it. The guideline also allows strategies without digital devices, with devices, or internet-based. This flexibility is an important mechanism so that schools with different resources can still begin computational and AI literacy (Astuti et al., 2025; Kementerian Pendidikan Dasar dan Menengah, 2025a).

This change can be read as an effort to maintain policy continuity. Flexibility remains the foundation, but the focus of implementation is shifting toward the quality of the learning experience and readiness for new technology. As a matter of policy, this approach is lower risk than replacing the entire curriculum framework, because schools do not have to start adaptation from zero. However, continuity is only beneficial if terminology change is followed by operational clarity. Deep Learning needs to be translated into task design, assessment, classroom interaction, and feedback. Likewise, Coding and AI need to be formulated as computational literacy and technology ethics, not merely

application-use skills. These findings extend the literature that previously largely assessed Kurikulum Merdeka in its early phase. Pratiwi *et al.* (2024) and Hasan et al. (2024) show that flexibility, project-based work, and orientation toward student needs are key features of the change from Kurikulum 2013. In the next stage, Rahmawati *et al.* (2025), Ambarita et al. (2025), and Ismayani dan Wahyudin (2025) show that the Deep Learning agenda is shifting attention from curriculum structure toward process quality. This means the next policy challenge is no longer merely whether schools use the new curriculum, but whether curriculum principles genuinely produce a more meaningful learning experience.

Table 1. Matrix of policy development, 2024–2025

Document	Function	Change/emphasis	Implication
Permendikbudristek 12/2024	Formal foundation for the ECED, primary, and secondary curriculum	Flexibility, curriculum structure, learning outcomes	Becomes a relatively stable basis for implementation
Permendikdasmen 13/2025	Amendment to the 2024 regulation	Strengthening of Deep Learning; Coding and AI as an elective; co-curricular adjustment	Adds future competencies without replacing the framework entirely
Kepmendikdasmen 127/P/2025	Implementation guideline for Coding and AI	Choice of strategy without devices, with devices, and internet-based	Opens a pathway for phased implementation according to resources
Panduan Koding dan AI 2025	Pedagogical guideline per phase	Computational thinking, AI literacy, ethics, privacy, bias, copyright	AI literacy needs to be positioned as a critical and responsible competency

Learning Achievement: National Improvement Has Not Closed the Competency Gap

The Rapor Pendidikan shows progress on a number of indicators. SD/MI numeracy reaching the minimum competency rose 13.44 percentage points between 2022 and 2024, while SMP/MTs literacy rose 5.35 percentage points. SD/MI learning quality in the Good category increased to 53.75% in 2024. These changes show room for optimism that the learning process can improve. However, around half of SD/MI students in 2024 still had not reached the minimum numeracy competency. This means curriculum development must continue to place literacy and numeracy as the foundation, rather than adding new material load that displaces the strengthening of basic competencies.

PISA provides an external comparison. Indonesia's score gap against the OECD average in 2022 was 106 points in mathematics, 117 points in reading, and 102 points in science. Only 18% of Indonesian students reached at least Level 2 in mathematics, compared with 69% for the OECD average; in reading 25% versus 74%; and in science 34% versus 76% (OECD, 2023). Because Level 2 is the threshold for the ability to use knowledge functionally in basic tasks, these figures support the need for learning that places greater emphasis on understanding and knowledge transfer.

Comparisons between Rapor Pendidikan and PISA must be made carefully because their instruments, populations, and scales differ. Rapor Pendidikan is used for national system evaluation and draws on the Asesmen Nasional and other administrative sources, while PISA samples 15-year-old students for international comparison. Their common message lies in the need to strengthen applied competency. Therefore, Deep Learning is relevant as a pedagogical direction, but the effectiveness of its implementation still needs to be tested with longitudinal data and an evaluation design able to distinguish the contribution of policy from other factors.

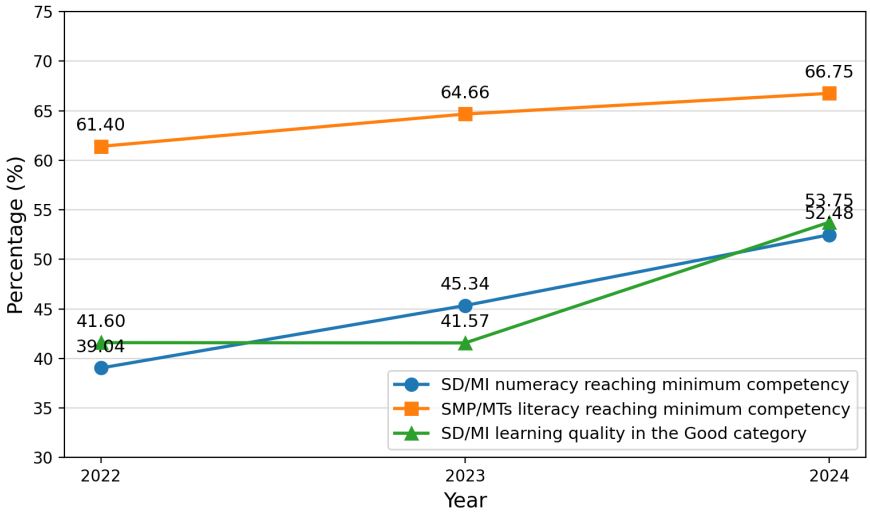


Figure 2. Selected indicators of the Rapor Pendidikan Indonesia, 2022–2024.
Source: authors' calculations based on Pratiwi et al. (2025).

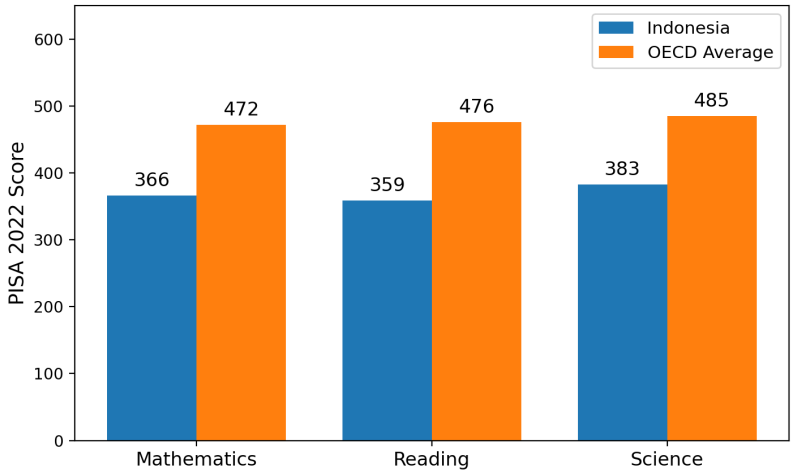


Figure 3. Average PISA scores for Indonesia and the OECD, 2022.
Source: authors' calculations based on OECD (2023).

These two data patterns convey different but complementary policy messages. Rapor Pendidikan shows that improvement can occur within the national system, while PISA shows the gap in Indonesia's competency in international comparison. Curriculum policy needs to keep its focus on foundational skills because literacy and numeracy are prerequisites for digital competency, problem-solving, and the use of AI. Expanding technology content without a strong reading and numeracy foundation risks producing surface-level competency. Therefore, the Coding and AI agenda should not displace the priority of literacy and numeracy, but rather be built upon them. The data also underline the limits of inference. The increase in national indicators from 2022 to 2024 coincided with the increasingly widespread implementation of Kurikulum Merdeka, but temporal correlation is not sufficient to conclude causation. Various other factors, such as post-pandemic learning recovery, assessment policy, teacher training, local government support, and socioeconomic conditions may have contributed. Therefore, this article's contribution is to carefully connect outcome evidence with policy direction, rather than attributing score changes to a single intervention.

Teacher Readiness as a Critical Point of Implementation

The most consistent theme in the corpus is teacher readiness. Kurniawan et al. (2024) concluded that Kurikulum Merdeka implementation in primary schools still faces teachers' incomplete understanding, limited competence, and inadequate facilities and infrastructure. Sephiawardani dan Bektiningsih (2023) found that implementation readiness relates not only to document

understanding, but also to the ability to develop learning tools and evaluate learning. In the Madrasah Ibtidaiyah context, Priatmoko *et al.* (2024) show that general readiness is relatively high, but learning and assessment aspects still need strengthening. These findings are reinforced by Syofiani et al. (2024) who reported deep understanding issues with learning-tool components among participants of the teacher professional education program. Kaluge dan Usmi (2024) also show that English-language teachers' readiness at secondary schools is not uniform. Ro'fah *et al.* (2025) concluded that Platform Merdeka Mengajar can support teachers' independent learning, but its effectiveness depends on user engagement, access, and the ability to make use of digital resources. This means the platform is not a substitute for a continuous professional-development strategy.

Rapor Pendidikan data add an equity dimension. In 2024, the proportion of public SD teachers who had attended training reached 62.54%, while private schools were around 46%, a gap of about 16 percentage points. This gap needs attention as policy demands increasingly complex skills, such as Deep Learning design and AI literacy. If teachers' learning opportunities are not equitable, curriculum flexibility can produce ever-widening differences in implementation quality. Professional development therefore needs to shift from one-off dissemination toward a continuous learning cycle. Teachers need practice demonstrations, opportunities to try things out, feedback, reflection, learning communities, and school leadership support. Ismayani dan Wahyudin (2025), in a mixed-methods study of 87 teachers with follow-up interviews at SMKN X Cianjur, recommend strengthening teacher capacity and learning communities as a strategy for Deep Learning implementation. This finding is in line with the idea that pedagogical change requires collective capacity, not just individual competency.

The consistency of the teacher-readiness theme across levels shows that this issue is systemic. Various studies in different contexts consistently show the importance of curriculum understanding, pedagogical competence, and institutional support (Al Arsyadhi et al., 2024; Ismayani & Wahyudin, 2025; Kaluge & Usmi, 2024; Priatmoko et al., 2024; Sephiawardani & Bektiningsih, 2023). Ro'fah *et al.* (2025) add that digital platforms can help teacher readiness, but their benefit depends on teachers' ability to access and turn these resources into practice. Thus, professional-development policy needs to assess transfer into the classroom, not merely the amount of training or the level of participation.

The implications for Deep Learning and Coding-AI are even greater. Both agendas require teachers to master learning design, authentic assessment, project management, digital literacy, and information evaluation. If support consists only of dissemination sessions, teachers tend to translate new policy into an administrative format. A more suitable professional-development model combines initial training, practice examples, coaching, peer observation, learning communities, and classroom-data-based feedback. Policy also needs to distinguish teachers' needs based on level, subject, experience, and school conditions.

Technology, AI, and the Risk of Implementation Gaps

Digital transformation opens opportunities to broaden learning resources, collaboration, assessment, and personalization. Sihombing *et al.* (2024) position technology as part of the transformation of the education system toward a more adaptive ecosystem. Subagyo et al. (2024) concluded that a technology approach can improve the effectiveness of primary school curriculum development, but limited access and integration difficulties remain obstacles. Habibah et al. (2025) also emphasize the urgency of teachers' digital literacy so that Kurikulum Merdeka does not stop at tool use without a change in pedagogical quality.

Statistik Pendidikan 2025 data show that 83.80% of students aged 5–23 have used the internet, but only 19.80% use a computer or laptop. This gap shows that high internet use has not been matched by computer or laptop use at the same level. This condition needs attention in the implementation of more complex digital learning, including Coding and Artificial Intelligence (Badan Pusat Statistik, 2025). In vocational education, Kasili *et al.* (2025) found that Kurikulum Merdeka is conceptually aligned with 21st-century skill demands, but implementation in SMK (vocational schools) is still constrained by teacher competence, technology facilities, consistency of Project-Based Learning, and industry partnerships. This finding shows that curriculum relevance to the world of work does not automatically produce graduate readiness if implementation capacity lags behind.

Coding and AI policy carries the same distributional risk. Educational units with devices, connectivity, informatics teachers, and management support can move faster. Schools with limited resources risk falling behind in competencies that increasingly determine social and economic participation. The official design that allows learning without devices is a mitigation step, but still requires standardized materials, training, and implementation support so that this option produces

equivalent minimum competency. Therefore, the success of digital transformation should not be measured by the number of applications or devices. More relevant indicators are changes in learning practice, task quality, students' ability to verify information, understand AI's limits, protect personal data, identify bias, and use technology to solve problems. Curriculum needs to avoid technology solutionism, the assumption that adding technology automatically improves learning.

AI integration adds an ethical dimension that was previously not prominent in education technology policy. The Coding and Artificial Intelligence guideline includes bias, privacy, copyright, system hallucination, and responsible use (Astuti et al., 2025). This shows that AI literacy needs to be defined more broadly than the ability to write prompts or run applications. Students need to be able to check the accuracy of outputs, understand model limitations, protect personal data, and know when AI use is inappropriate. Such standards can be taught gradually, even in schools with limited facilities, through unplugged activities, case analysis, and information-verification exercises.

The risk of inequality arises when innovation depends entirely on school readiness. Schools with better connectivity, devices, and teachers will develop AI projects faster, while schools with limited capacity may be left behind. Therefore, flexibility needs to be accompanied by a national baseline that guarantees every student receives minimum exposure to computational thinking, data security, AI ethics, and information evaluation. More advanced implementation can remain a contextual option, but basic learning rights should not depend entirely on local resources.

Equity and Regional Governance

The national curriculum is applied across highly varied geographic conditions and institutional capacities. Teacher constraints in 3T regions relate to limited resources and implementation support (Lase, 2024). Rapor Pendidikan 2025 also shows an uneven achievement pattern across regions, with some parts of eastern Indonesia still facing a lower proportion of minimum competency compared to many regions in Java, Bali, and western Indonesia. The same policy therefore requires different intensities of support. Alhapip *et al.* (2024) show that the challenge is not only about school resources. A study using Soft Systems Methodology found conflicts in the form of misalignment between local authorities and schools, differing interpretations between supervisors and school communities, and underused digital support systems. They propose a knowledge-management approach so that local governments play an active role in disseminating and using policy knowledge. This finding is important because curriculum flexibility requires interpretation and coordination capacity at the regional level.

A more appropriate equity principle is equity itself, not the provision of identical inputs. Regions with low achievement or limited access to training need more intensive support: implementation mentoring, devices and learning resources that can operate offline, strengthening of teacher communities, incentives for improving digital competency, and indicator-based monitoring. Affirmative policies of this kind can help ensure that adding Coding and AI does not create a new layer of inequality. From a public-policy perspective, variation in regional capacity requires differentiated implementation. National targets can remain the same, but the pathways to achieving them need to differ based on readiness level. Regions with low connectivity need offline materials, device support, and technical mentoring. Regions with a shortage of teachers need strengthened teacher networks and access to remote professional learning. Regions with low literacy and numeracy achievement need foundational interventions before expanding the advanced technology agenda. This approach is more consistent with the principle of equity than uniform program distribution.

Alhapip *et al.* (2024) show the importance of local government's role in Kurikulum Merdeka implementation. This finding means curriculum evaluation is not sufficient if it only assesses schools and teachers. Local governments' capacity to interpret policy, allocate budgets, provide mentoring, and use data also needs to be monitored. In practice, the national curriculum is translated through a governance chain involving the central government, local governments, supervisors, school principals, teacher communities, and educators. A weakness in any link of this chain can produce inconsistent implementation.

Table 2. Synthesis matrix of the 23 studies reviewed

Source	Context/design	Key findings	Policy implications
Sephiawardani dan Bektiningsih (2023)	Public SD; teacher readiness	Device readiness, understanding, and evaluation not yet uniform	Strengthening implementation competency
Dirgantoro dan Soesanto (2023)	Pre-service teachers/teacher-education institutions	General readiness positive; some still need deeper understanding	Strengthening pre-service education
Kurniawan et al. (2024)	SLR, primary schools	Teacher understanding, competence, and facilities are recurring barriers	Training, collaboration, facilities
Priatmoko et al. (2024)	Madrasah Ibtidaiyah	General readiness good, learning/assessment aspects need strengthening	Practice-based mentoring
Pratiwi et al. (2024)	SLR, K13 vs Merdeka in primary schools	Merdeka more flexible and contextual; teachers face new demands	Flexibility needs capacity support
Lase (2024)	3T region	Limited resources burden implementation	Region-based affirmation
Alhapip et al. (2024)	Local government, supervisors, schools	Coordination, interpretation, and digital support not yet effective	Regional knowledge management
Syofiani et al. (2024)	Teacher professional-education program participants	Understanding of learning tools not yet deep	Continuous professional development
Subagyo et al. (2024)	Literature review, primary school technology	Technology helps learning but access/integration remains a constraint	Technology follows pedagogical goals
Sihombing et al. (2024)	Technology-based education transformation	Digitalization supports education-system adaptation	Transformation governance needed
Ro'fah et al. (2025)	Literature review, PMM	PMM supports readiness but depends on access and engagement	Platform as part of the PD ecosystem
Kasili et al. (2025)	SLR, SMK-Industry 4.0	Teachers, facilities, PjBL, and industry partnerships remain obstacles	Strengthening the vocational ecosystem
Rahmawati et al. (2025)	Literature study, Deep Learning	Mindful, meaningful, joyful requires systemic change	Do not reduce to an administrative format
Ambarita et al. (2025)	Thematic literature review	Institution, teacher, technology, and assessment readiness are decisive	Integrated pedagogical reform
Nurhasanah et al. (2025)	SLR, 31 articles	PjBL, inquiry, reflection effective; implementation needs system support	Teacher PD, assessment, infrastructure
Ismayani dan Wahyudin (2025)	Mixed methods, 87 SMK teachers	Internal strength important; learning communities recommended	Strengthening school capacity
Habibah et al. (2025)	SLR, MI teachers' digital literacy	Digital literacy urgent for adaptive curriculum implementation	Strengthening teacher digital literacy

Source	Context/design	Key findings	Policy implications
Hasan et al. (2024)	SLR, implementation in primary schools	Flexibility offers differentiation opportunities but school readiness varies	Contextual implementation support
Jufriadi et al. (2022)	Analysis of 21st-century competencies	Flexible learning experience related to communication, creativity, critical thinking, collaboration	Orientation toward applied competency
Kaluge dan Usmi (2024)	SMA English teachers	Teacher readiness for Kurikulum Merdeka not uniform	Subject-specific training
Mustofiyah et al. (2024)	SLR, STEM-based curriculum	STEM relevant to digital-era competency and requires pedagogical readiness	Gradual cross-disciplinary integration
Puspitasari (2025)	Adaptive digital-era curriculum model	Curriculum needs to integrate 21st-century, digital, and sustainability competencies	Competency-based adaptive curriculum
Al Arsyadhi et al. (2024)	Evaluation of SD teacher readiness	Readiness level influenced by understanding, training, and implementation support	Mapping readiness before intervention

Policy Synthesis and Intervention Priorities

Based on the overall evidence, the direction of Indonesian curriculum policy is relatively strong on the relevance dimension, but not yet uniform on the capacity and equity dimensions. Kurikulum Merdeka, Deep Learning, and Coding and AI address the need for flexibility, understanding, problem-solving ability, and technology literacy. The main issue has shifted from "what must be written into the curriculum" toward "how to ensure every school is able to realize it."

First, the stability of the curriculum framework needs to be maintained. The 2025 change, being an adjustment, is more productive than a total replacement because it reduces adaptation costs. Periodic evaluation can be used to improve learning outcomes, guidelines, assessment, and support programs without building the perception that schools must start over from zero every time there is a change of government or technology.

Second, teacher development needs to become core policy, not a supplementary program. Training targets must shift from the number of participants toward changes in competency and practice. The government can use Rapor Pendidikan data to identify schools with low access to professional development and provide more intensive mentoring. Models of learning communities, coaching, lesson study, and practice-sharing can extend the impact of formal training.

Third, the government needs to establish a minimum AI-literacy standard achievable across various resource conditions. The standard can cover computational thinking, the basics of how AI works, output verification, privacy, bias, copyright, ethics, and responsible prompt use. Implementation may differ between schools with and without devices, but minimum competency should not depend entirely on a school's fiscal capacity or location.

Fourth, curriculum evaluation needs to combine outcome indicators and capacity indicators. Outcomes can include literacy, numeracy, digital competency, and learning quality. Capacity includes teacher training experience, use of learning communities, infrastructure readiness, leadership quality, and local government support. This approach prevents the policy error of replacing the curriculum when the main problem actually lies in implementation.

Fifth, digital transformation needs to be subordinate to pedagogical goals. Technology is used when it improves the quality of interaction, access, feedback, exploration, and problem-solving. Procuring devices without learning design and teacher development risks producing high costs with low learning impact. This principle also applies to generative AI, which needs to be used with transparency, verification, and restrictions appropriate to the assessment context.

The synthesis framework in this study positions curriculum policy as a relationship among four dimensions. Relevance answers whether competencies and learning experiences match students' needs and global change. Capacity answers whether teachers and schools are able to carry out the policy. Equity answers whether learning opportunities and implementation support are available to different groups. Governance answers whether policy change, funding, mentoring, and evaluation

move consistently. Failure in one dimension can reduce the benefit of the others. A relevant curriculum is not enough if schools lack capacity, while capacity investment is not effective if policy direction keeps changing without evaluation.

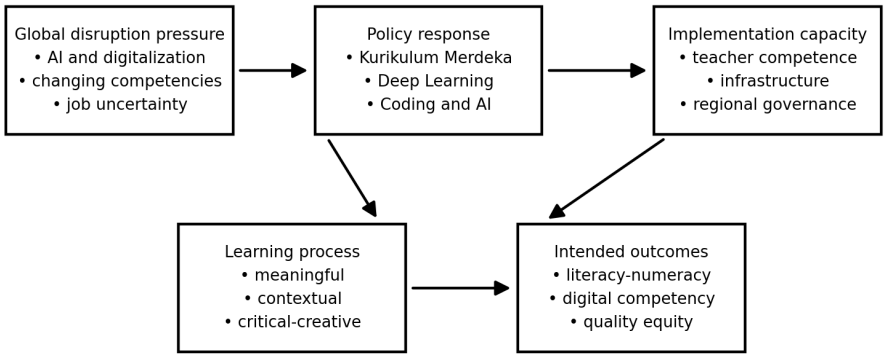


Figure 4. Synthesis framework for an adaptive and equitable curriculum policy.

From this framework, policy stability needs to be understood as stability of goals and core architecture, not a halt to innovation. Technological change can be handled through updates to guidelines, learning examples, elective competencies, and professional development without replacing the entire curriculum identity. This model gives teachers time to build expertise and enables longitudinal evaluation. Policy change that is too rapid makes it difficult to separate design failure from implementation failure, because schools have not yet had the chance to reach an adequate level of maturity.

Evaluation also needs to shift from administrative compliance toward learning improvement. Administrative indicators such as the number of schools adopting a program or the number of teachers attending training remain useful, but are not sufficient. The government needs to connect input indicators with changes in classroom practice, task quality, formative assessment, student engagement, competency achievement, and gaps between groups. Rapor Pendidikan provides a data infrastructure that can be used for targeting, but the data need to be complemented with implementation evaluation and research able to explain why changes occur.

Table 3. Evidence-based policy priorities and monitoring indicators

Issue	Evidence-based problem	Intervention priority	Monitoring indicator
Teacher readiness	Understanding and implementation competency uneven	Continuous PD, coaching, learning communities, needs-based support	Change in classroom practice, not the number of training participants
Literacy and numeracy	Achievement improving but many students still below minimum	Maintain focus on foundational competency within Deep Learning	Proportion reaching minimum competency, and the gap
Coding and AI	Risk of gaps between high- and low-resource schools	Minimum AI-literacy standard + pathways without devices/with devices	Access to, and mastery of, safe/ethical AI competency
Digital infrastructure	Access to and integration of technology varies	Affirmation for connectivity, devices, offline resources, technical support	Use linked to learning activity

Issue	Evidence-based problem	Intervention priority	Monitoring indicator
Regional governance	Policy interpretation and coordination not always aligned	Knowledge management, mentoring, use of Rapor Pendidikan	Consistency of implementation and data follow-up
Policy stability	Too-frequent change increases adaptation burden	Evaluation-based incremental refinement	Continuity of implementation and reduced administrative burden

Implications for Education Policy and Research

For policy, the results of this study show that Indonesian curriculum development should use the principle of adaptive stability. The core framework is maintained long enough to give room for implementation, while supporting components are updated based on evidence. This principle can reduce transition costs, prevent change fatigue among teachers, and increase the chances of more valid evaluation. Adding Deep Learning and Coding and AI onto the existing framework is an example of a phased approach, but the quality of its implementation needs to be monitored so that it does not turn into an added administrative burden. For teacher development, policy needs to shift attention from access to training toward the quality of professional learning. The system can use school data to identify needs, provide the same basic modules, and then offer differentiated support. Teachers who are already ready can be given room to develop advanced practice and become mentors, while teachers who need support can receive more intensive coaching. At the same time, pre-service teacher education needs to incorporate Deep Learning design skills, data literacy, and AI literacy so that readiness is not built only after someone enters the school.

For research, the existing literature is still dominated by perception, readiness, case, and literature-review studies. This evidence is important for understanding processes, but is not yet sufficient for assessing impact. Future research needs to use longitudinal designs, quasi-experimental designs where possible, natural experiments across regions, and mixed methods that connect changes in practice with learning outcomes. Implementation of Coding-AI and Deep Learning also needs clear indicators so that evaluation does not stop at positive attitudes or acceptance levels. Research needs to distinguish between exposure to policy, implementation fidelity, practice quality, and student outcomes. This article's theoretical contribution is showing that curriculum analysis in an era of disruption requires a broader unit of analysis than curriculum content. Regulation, system performance, implementation capacity, equity, and governance interact with one another. The resulting three-layer evidence framework and four-dimension evaluation framework can be used to compare subsequent policy phases. With this framework, the evaluation question does not stop at “is the new policy relevant?”, but continues to “who is able to implement it, who is at risk of being left behind, which indicators are changing, and what governance mechanism explains that change?”

Research Limitations

This study has several limitations, among others: the heterogeneity of research designs does not allow the calculation of effect size or meta-analysis; some of the policies discussed, particularly Deep Learning and Coding and AI, are still in an early implementation phase so long-term outcome evidence is not yet available; PISA and Rapor Pendidikan data use different populations, instruments, and scales so both should not be read as identical measures; and this article is not designed to conclude causality between curriculum change and improvement in education indicators. These limitations were managed through triangulation, source transparency, separation between outcome evidence and implementation evidence, and limiting conclusions to patterns that are consistent across sources.

CONCLUSION

Indonesia's curriculum policy transformation in 2024–2025 shows a pattern of adaptive continuity: the flexibility of Kurikulum Merdeka is maintained, while the focus is strengthened through Deep Learning and the introduction of Coding and Artificial Intelligence. This direction is relevant to competency needs in an era of disruption, but achievement evidence shows that foundational priorities remain urgent. Rapor Pendidikan shows improvement in literacy, numeracy, and learning quality across a number of indicators, while PISA 2022 confirms that Indonesia's competency gap relative to

the OECD average is still large. The literature consistently shows that teacher readiness, the quality of professional development, digital infrastructure, variation in regional capacity, and implementation governance are critical points. Therefore, future policy needs to maintain the stability of the curriculum framework, strengthen practice-based teacher development, establish an inclusive AI-literacy baseline, use affirmative interventions according to regional needs, and connect curriculum evaluation with outcome and capacity indicators. This study's scientific contribution is a framework linking regulatory change, system performance, and implementation capacity through the dimensions of relevance, capacity, equity, and governance. This framework can serve as a basis for evaluating the next policy phase while preventing causal claims that go beyond the evidence.

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DECLARATION OF GENERATIVE AI

The authors declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

CONFLICTING INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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