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Adaptive Curriculum Development Management Framework: A Systematic Literature Review on Student Needs and Teacher Competence

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ABSTRACT

Curriculum quality is central to educational effectiveness, yet research on curriculum management, student needs, teacher competence, and adaptive education has largely developed in isolation. This study systematically examines how curriculum development management grounded in students' learning needs and teachers' professional competencies can be integrated within an adaptive education framework. Following the PRISMA 2020 guidelines, a Systematic Literature Review (SLR) was conducted. From an initial pool of 847 records, 32 peer-reviewed articles retrieved from major international databases (Scopus, Web of Science, ScienceDirect, Springer, Wiley, PubMed) and nationally accredited SINTA journals met the inclusion criteria and underwent thematic analysis. Four interrelated themes emerged: (1) student needs analysis as the foundation of curriculum planning; (2) teacher competence as the core driver of adaptive implementation; (3) Universal Design for Learning (UDL) as the primary design framework; and (4) responsive, data-informed evaluation and feedback mechanisms. Synthesizing these dimensions, this study proposes the Integrative Conceptual Framework of Adaptive Curriculum Management (KIMKA). The framework conceptualizes a dynamic, cyclical model that positions students need as a continuous reference point, treats teachers as active co-developers, and frames evaluation as an ongoing reflective practice. The primary novelty lies in this holistic, non-linear conceptualization, offering key theoretical and practical implications for educational leaders, policymakers, and practitioners—particularly in advancing inclusive curriculum reform such as Indonesia's Kurikulum Merdeka.

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1. INTRODUCTION

Quality education cannot be separated from the quality of the curriculum that guides the teaching-learning process. Within a continuously evolving education system, the

curriculum must respond to the diversity of learners' needs while ensuring that teachers, as the primary implementers, continue to develop their competencies in proportion (Anugrah et al., 2024; Hidayat et al., 2025). Curriculum is not merely a formal document listing subjects, but rather a plan and arrangement of goals, content, materials, and methods used as guidelines for organizing learning activities to achieve specific educational objectives (Coşkun Yaşar & Aslan, 2021; El-Astal, 2023). Wirtati et al. (2025) define curriculum management as a cooperative, comprehensive, systemic, and systematic management system aimed at realizing curriculum goals.

More operationally, Suwarni (2023) details that curriculum development management encompasses the processes of planning, organizing, implementing, and supervising all activities related to curriculum development, ranging from the formulation of philosophical foundations to the evaluation of curricula already in place. Hadisaputra et al. (2024) reinforce this view, arguing that effective curriculum management involves not only the technical aspects of syllabus and lesson-plan preparation, but also strategic planning, resource organization, implementation, and continuous evaluation of learning outcomes. Curriculum development models vary considerably: Taba's model emphasizes an inductive process that foregrounds teacher involvement (Asuncion et al., 2023), whereas Tyler's model follows a deductive approach that aligns educational goals with learner needs, notwithstanding criticism of its linear character (Afriadi & Fitri, 2025).

Evidence from practice indicates that curriculum development in Indonesia continues to face fundamental challenges. The gap between curriculum design and the actual needs of students in the classroom remains a persistent, unresolved problem. Maryati et al. (2024) note that effective curriculum evaluation enables education managers to make data-driven decisions, allocate resources appropriately, and adopt evidence-based practices that drive continuous improvement. Unfortunately, such evaluation practices have yet to become an embedded institutional culture in many Indonesian educational institutions.

Students' learning needs constitute the primary foundation for meaningful curriculum planning (Belbase et al., 2022). Comprehensive needs analysis enables educators to identify gaps between existing learning conditions and desired ideal conditions, ensuring that the resulting curriculum is genuinely relevant and responsive (Sutrisno et al., 2024). Through a Campbell systematic review and meta-analysis, Bernard et al. (2019) found that individualized, adaptive instructional approaches tailored to learners' needs positively affect the academic achievement of K-12 students, and that learning effectiveness is strongly shaped by teachers' role as facilitators and by their capacity to adjust activities and materials to learners' characteristics. Abu-Rasheed et al. (2023) further argues that identifying learners' needs must be undertaken contextually, considering the learning environment, family background, cognitive style, and students' potential and interests.

Teacher competence, as the spearhead of curriculum implementation, is a critical variable that is frequently overlooked in curriculum planning (Tran & O'Connor, 2024). Without pedagogically competent teachers, even a well-designed curriculum remains

little more than a stored document with no meaningful impact on learners (Manizabayo & Kachchhap, 2025). Through a systematic review of 56 articles drawn from Web of Science, Scopus, ERIC, Dialnet, and Google Scholar, Salmerón Aroca et al. (2022) found that initial, continuous, and lifelong training are the principal drivers of teacher competence, with younger teachers tending to be more proficient in information and communication technology while senior teachers exhibit stronger relational and procedural competencies in the classroom. Talvio et al. (2024) add that professional-development programs that are personalized and grant schools' greater autonomy are more effective in fostering teaching innovation than uniform, centrally standardized training.

Tarmo and Kimaro (2021), in a study, analyzed Tanzania's education curriculum and found that competency-based curriculum reform depends heavily on teachers' capacity to translate competency standards into everyday instructional practice; teachers trained only in subject content, without corresponding training in competency-based pedagogy, struggle to implement curricula oriented toward learner outcomes. Leatemia et al. (2023) corroborates this finding, showing that teacher profiles conducive to student-centered learning are characterized by a strong belief in the value of active learning, a robust pedagogical identity, and a genuine commitment to supporting learners' growth.

The concept of adaptive education has emerged as an approach that holistically bridges curriculum development and teacher competence (Thaariq, 2026). From this perspective, the curriculum is not designed as a uniform package applied identically to all students, but rather as a flexible framework that can be tailored to each learner's needs, learning style, and abilities (Strielkowski et al., 2025). This approach is consistent with the principles of Universal Design for Learning (UDL), which promotes multiple means of representation, expression, and engagement to accommodate learner diversity (Levey, 2023; Rusconi & Squillaci, 2023). Scholars have argued that inclusive curricula designed around UDL principles require comprehensive redesign to remove barriers to learning, rather than the mere addition of accommodations at the margins of an existing curriculum, and that adaptive systems produce moderate-to-large effects on learners' cognitive achievement when teachers actively guide their use in a data-informed manner (Kelly et al., 2022; Priyadharsini & Mary, 2024; Thoriq & Mahmudah, 2023).

In Indonesia, the implementation of adaptive curricula continues to face substantial challenges (Thaariq, 2026; Wildan et al., 2026). Systematic reviews on the development of adaptive curricula for elementary schools in the digital era report that key obstacles include limited digital infrastructure, teachers' low digital competence, and disparities between urban and rural schools. Lubis and Syawalina (2024) and Utami et al. (2025) similarly find that the implementation of formative assessment within Indonesia's Kurikulum Merdeka (Independent Curriculum) still requires substantial strengthening of teacher capacity. Together, these findings indicate that curriculum reform, however well planned, will encounter serious obstacles unless accompanied by strengthened teacher evaluation capacity.

Taking together, the studies reviewed above show that discourse on curriculum management, student needs, teacher competence, and adaptive education has developed

largely in parallel, yet remains fragmented: each topic tends to be examined separately, without an integrative and dynamic conceptual framework connecting them. This gap constitutes the novelty of the present study. To the best of our knowledge, this is the first study to explicitly construct an integrative conceptual framework linking student-needs-based curriculum development management, the strengthening of teacher competence, and the principles of adaptive education (including UDL) within a single cyclical, non-linear model. Unlike previous studies, which typically capture only one or two of these three components, the present study offers a more comprehensive perspective that positions students need as a constant reference point to which every stage of curricular decision-making is continually returned.

Building on this rationale, the present study addresses the following central research question: How can curriculum development management based on student needs and teacher competence be realized within an adaptive education framework? Accordingly, this study aims to: (1) identify recent research findings on adaptive curriculum management; (2) synthesize curriculum management principles that are responsive to student needs and teacher competence; and (3) construct an integrative conceptual framework as a theoretical contribution to the development of educational management in Indonesia.

2. METHOD

This study employs a Systematic Literature Review (SLR) approach, a method designed to identify, select, evaluate, and synthesize research relevant to an explicitly formulated research question. Unlike a narrative review, which tends to be more subjective, an SLR applies a structured, transparent protocol to minimize bias in the selection and interpretation of the literature. The literature search was conducted systematically across eight major databases: Scopus, Web of Science (WoS), PubMed, ScienceDirect, SpringerLink, Wiley Online Library, Google Scholar, and the Indonesian national portals Garuda and SINTA. The search period was restricted to 2015-2025 to ensure the relevance and currency of the evidence base. Search terms were combined using the Boolean operators AND/OR and included: "curriculum development management", "student needs", "teacher competency", "adaptive education", "systematic literature review", "*manajemen kurikulum* (curriculum management)", "*kebutuhan siswa* (student needs)", "*kompetensi guru* (teacher competence)", and "*pendidikan adaptif* (adaptive education)".

Inclusion criteria were: (1) articles published between 2015 and 2025; (2) written in Indonesian or English; (3) indexed in internationally reputable databases (Scopus, WoS, PubMed, ScienceDirect, Springer, Wiley) or published in nationally accredited SINTA 1-6 journals; (4) possessing a valid Digital Object Identifier (DOI); and (5) focused on curriculum management, student learning needs, teacher competence, or adaptive education. Exclusion criteria comprised articles without accessible full text, opinion pieces lacking empirical data or an adequate theoretical review, and duplicate records.

The selection process followed the four-stage PRISMA 2020 flow (Page et al., 2021): identification, screening, eligibility, and inclusion. Of 847 records initially identified,

412 were removed as duplicates. Following title and abstract screening, 198 articles remained and were assessed for eligibility through full-text reading. Ultimately, 32 articles satisfied all inclusion criteria and constituted the analytic corpus (see Figure 1 for the selection summary). A thematic analysis approach was then used to identify recurring patterns, themes, and gaps across the included literature.

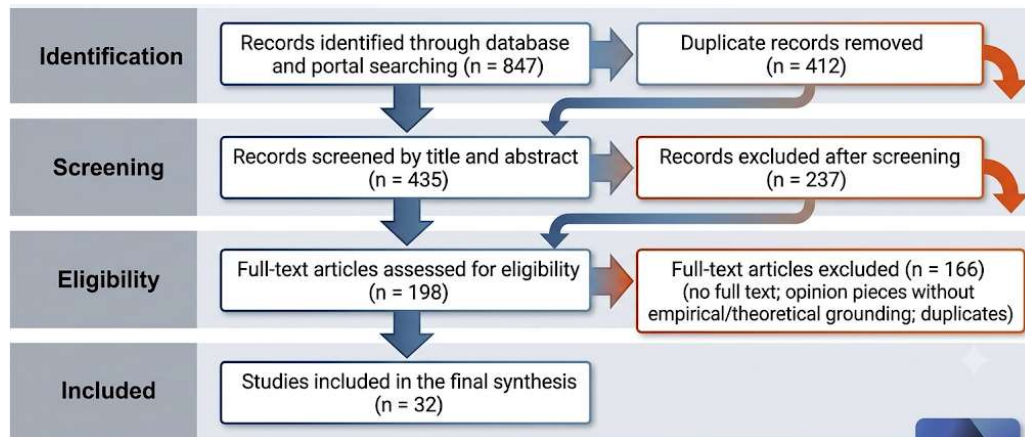


Figure 1. PRISMA 2020 Study Selection Process

3. RESULTS AND DISCUSSION

Results

This section presents the descriptive metrics and thematic results derived from the corpus analysis, deliberately reserving interpretative synthesis for the subsequent Discussion section. The temporal distribution of the 32 reviewed articles highlights a distinct upward trajectory, with a significant majority published between 2021 and 2024 (68.75%). This temporal concentration underscores an accelerating scholarly engagement with adaptive curriculum management, driven primarily by the imperatives of the post-pandemic educational ecosystem. Regarding publication provenance, 65.62% ($n = 21$) of the selected studies were retrieved from high-impact international indexing databases—namely Scopus, Web of Science, ScienceDirect, Springer, and Wiley—thereby establishing a robust global foundation. The remaining 34.38% ($n = 11$) were sourced from high-tier nationally accredited journals (SINTA), ensuring the inclusion of valuable contextualized regional perspectives.

From a methodological standpoint, the corpus demonstrated a strong inclination toward systematic literature reviews, which accounted for 40.6% ($n = 13$) of the reviewed literature, reflecting a primary research priority on consolidating dynamic pedagogical models. Empirical methodologies were also prominently represented through qualitative approaches (31.3%, $n = 10$) and mixed-methods frameworks (18.7%, $n = 6$), whereas the residual subset comprised quantitative meta-analyses and classroom action research studies (Table 1). Inductive thematic mapping across the aggregated dataset yielded four core thematic clusters that delineate the structural, operational, and pedagogical dimensions of adaptive curricula. These empirical and

thematic findings are detailed below to provide a foundational baseline for the subsequent critical synthesis.

Table 1. General characteristics of the 32 included studies

Characteristic	Category	n	%
Publication year	2015-2020	4	12.5
	2021-2024	22	68.75
	2025	6	18.75
Publication source	International reputable journals (Scopus/WoS/ScienceDirect/Springer/Wiley)	21	65.6
	Nationally accredited SINTA journals	11	34.4
Research method	Systematic literature review	13	40.6
	Qualitative research	10	31.3
	Mixed methods	6	18.7
	Meta-analysis / classroom action research	3	9.4

Student Needs Analysis as the Foundation of Curriculum Planning

Literature consistently positions students need analysis as a non-negotiable foundation for effective curriculum design. [Maryati et al. \(2024\)](#) found that curriculum evaluation involving stakeholders collaboratively and inclusively enables institutions to develop curricula that are responsive to learners' needs. A systematic review by [Anwar et al. \(2025\)](#) of differentiated-instruction research published between 2020 and 2025 found that strategies such as flexible grouping, tiered instruction, and enrichment were consistently used to accommodate diverse learning needs, with reported positive contributions to student engagement, motivation, and learning outcomes.

[Sutrisno et al. \(2024\)](#) more specifically concluded that needs analysis of teacher competence in facilitating student-centered learning reveals a tangible gap between curricular expectations and teachers' actual capacity to manage diverse student needs, indicating that needs analysis must address both the student and teacher levels simultaneously. Systematic reviews on adaptive curriculum development for elementary schools in the digital era likewise found that adaptive curricula improve student participation and comprehension when supporting conditions are in place, although infrastructure constraints and teachers limited digital competence remain major barriers.

Teacher Competence as the Driver of Adaptive Curriculum Implementation

Twenty-three of the 32 articles (71.9%) identify teacher competence as the single most decisive variable in successful curriculum implementation. [Salmerón Aroca et al. \(2022\)](#) found that intelligent school systems require differentiated teacher-training approaches according to career stage and generational cohort: younger teachers tend to be more proficient in information and communication technology, while senior teachers possess deeper relational and procedural competence. This implies the need for differentiated, personalized teacher competency-development programs, mirroring the very principle of differentiation demanded of student learning.

[Talvio et al. \(2024\)](#) conclude that innovation in teacher education must encompass twenty-first-century skills, social-emotional learning, and the pedagogically grounded

use of technology, and that professional-development programs granting schools autonomy and peer support are more effective at fostering teaching innovation than uniform, centralized training. Tarmo and Kimaro (2021) add that competency-based curriculum reform depends heavily on teachers' capacity to translate standards into practice; without this capacity, reform stalls at the level of documentation.

Universal Design for Learning as the Framework for Adaptive Curriculum

Universal Design for Learning (UDL) emerges as the most consistently cited framework underpinning inclusive, adaptive curriculum design. Espada-Chavarria et al. (2023) found that implementing UDL and Universal Design for Instruction (UDI) in higher education yields high levels of student satisfaction and significantly affects motivation and comprehension, including among students with special needs. Beck Wells (2022) found that UDL implemented in virtual formats in higher education can be a highly useful tool for supporting heterogeneous student populations.

AlRawi and AlKahtani (2022) confirmed considerable diversity in research designs and intervention approaches for UDL implementation among students with intellectual disabilities, concluding that UDL implementation requires careful contextualization to the educational setting concerned. Korobkova et al. (2025) reinforced this finding, reporting that adaptive systems produce moderate-to-large effect sizes on cognitive achievement when implementation is supported by active teacher guidance, systematic design, and the integration of online and offline learning.

Responsive Evaluation and Feedback Mechanisms

The reviewed literature consistently indicates that responsive, data-informed evaluation mechanisms are an inseparable component of effective adaptive curriculum management. Maryati et al. (2024) found that comprehensive curriculum evaluation provides insight into student performance, engagement, and overall satisfaction, enabling continuous improvement and adaptation to be evolving educational trends. Utami et al. (2025) specifically found that the implementation of formative assessment within Indonesia's Kurikulum Merdeka still requires strengthened teacher capacity to design relevant and varied assessment instruments, indicating a persistent gap between curriculum policy and teachers' evaluation capacity.

Leatemia et al. (2023) found that teacher profiles associated with positive student-centered learning outcomes are those who actively use formative feedback as an instrument for adjusting instructional strategy, indicating that evaluation is not merely an end-of-cycle administrative task but a continuous reflective process integral to the daily practice of competent teachers.

Discussion

The four themes identified in the Results are not independent; rather, they are interconnected within a dynamic, reciprocal network of relationships. Comprehensive student needs analysis will not translate into meaningful change without teachers who have the capacity to respond to their findings through adaptive instructional design.

Conversely, high teacher competence that is not grounded in actual students needs data risks producing instruction that is technically efficient but contextually irrelevant for learners.

This finding aligns with [Hadisaputra et al. \(2024\)](#), who argue that effective curriculum management reflects a balance among spiritual, academic, and social dimensional balance that requires active collaboration among all stakeholders, from central policymakers to classroom teachers, within a mutually supportive ecosystem. In other words, adaptive curriculum management is not merely a matter of technology or method, but of institutional culture that positions learners' needs as a constant reference point in every pedagogical decision.

The Proposed Integrative Conceptual Framework (KIMKA)

Drawing upon a critical synthesis of the empirical and thematic evidence, this study formulates the Integrative Conceptual Framework of Adaptive Curriculum Management (Kerangka Integratif Manajemen Kurikulum Adaptif, KIMKA), structured as a four-tier, dynamically interconnected, and iterative system (Figure 1). Rooted in Bronfenbrenner's ecological systems theory ([El Zaatari & Maalouf, 2022](#)) and sociocultural perspectives on learning by Vygotsky ([Grossen et al., 2022](#)), the operational architecture begins with the Learning Ecosystem Analysis, serving as both the primary entry point and the recurrent locus for every curriculum-development iteration. This diagnostic dimension systematically evaluates multidimensional parameters, including heterogeneous student learning profiles, educator capability vectors, institutional resource allocations, and ambient socio-cultural determinants. Building upon these empirical baselines, the Adaptive Curriculum Design component aligns with the core principles of Universal Design for Learning ([Rusconi & Squillaci, 2023](#)) and Tomlinson's framework for differentiated instruction across content, process, and product domains ([Dack & Ann Tomlinson, 2025](#)). By embedding structural pedagogical flexibility, this design matrix ensures that curricular architectures remain intrinsically responsive to evolving learner demographics and contextual shifts, departing from the rigid, linear paradigms historically critiqued in traditional curriculum development by Tyler ([Ashari et al., 2023](#)).

The operationalization of this framework is sustained through Competency-Based Implementation, grounding itself in by Fullan's ([Akala, 2021](#)) theory of educational change and [Hargreaves and Fullan's \(2020\)](#) concept of professional capital. This phase demands high levels of pedagogical, personal, social, and professional competence among teaching staff, bolstered by transformative instructional leadership from school administrators ([Hallinger, 2026](#)) and active engagement within collaborative professional learning communities ([Christensen & Jerrim, 2025](#)). Crucially, the model closes its feedback loop through Continuous Evaluation and Adaptation, extending [Deming's Plan-Do-Check-Act \(PDCA\) quality cycle](#) to educational governance. This mechanism redefines assessment from a terminal, summative exercise at the conclusion of an academic term into a continuous, data-informed diagnostic compass by Black & Wiliam ([DeLuca & Richardson, 2026](#)). By leveraging real-time formative data streams

to drive ongoing, mid-course adjustments, this cyclical feedback loop reinforces organizational learning by Senge (Hansen et al., 2020) and ensures long-term curricular resilience within dynamic educational landscapes.

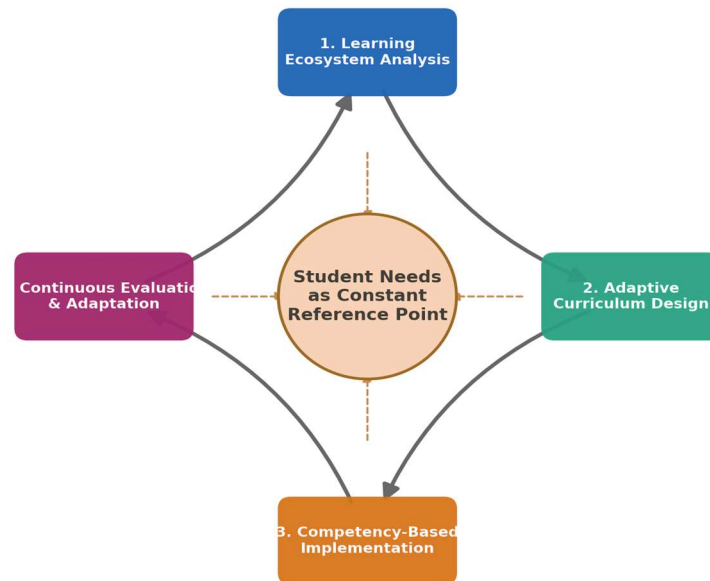


Figure 2. Integrative Conceptual Framework of Adaptive Curriculum Management (KIMKA)

The KIMKA framework differs from conventional curriculum management models in three key respects. First, the process is non-linear and cyclical: feedback from implementation and evaluation can trigger revisions to the planning stage at any point, not only at the end of an academic cycle. Second, teachers are treated as curriculum co-developers rather than mere implementers, making teacher competence an active variable that develops in tandem with curriculum refinement. Third, student needs are positioned as a constant reference point to which every stage of curricular decision-making is continually returned, making the curriculum genuinely learner-centered in practice, not only in name.

Implications for the Indonesian Education Context

Within the context of Indonesia's Kurikulum Merdeka, the proposed KIMKA framework carries direct and contextual relevance. Kurikulum Merdeka explicitly foregrounds instructional differentiation, character strengthening, and school-level flexibility to develop curricula suited to local contexts. However, the success of this policy depends substantially on teachers' capacity to manage learning diversity adaptively and on a data-informed basis—a capacity that, according to Utami et al. (2025), still requires significant strengthening.

At the same time, disparities in implementation quality between urban and rural schools, between public and private schools, and between Java and regions outside Java call for contextual and differentiated capacity-building approaches. Generic, centralized teacher-training programs have proven insufficiently effective (Salmerón Aroca et al.,

2022); what is needed instead is a professional-learning-community approach that enables teachers to learn from and with peers within the real context of their own schools. School principals play a key role as instructional leaders who facilitate the formation of such learning communities while ensuring that evaluation feedback is actively used to revise and continuously improve the curriculum.

Limitations and Directions for Future Research

This study has several limitations that warrant acknowledgment. First, restricting the search to Indonesian- and English-language sources may have excluded relevant perspectives from researchers publishing in other languages who may have developed comparable adaptive curriculum management models. Second, as a purely literature-based study without primary data collection, this research is limited in its ability to empirically verify the proposed conceptual framework under actual school conditions in Indonesia. In light of these limitations, future research is recommended to: (1) conduct empirical case studies on the effectiveness of the KIMKA framework in schools that have implemented Kurikulum Merdeka across diverse geographic and socio-economic contexts; (2) develop an instrument for assessing adaptive curriculum management capacity for use by school principals and education supervisors; and (3) examine the role of principals' transformational leadership in creating an institutional ecosystem conducive to the sustained implementation of adaptive curricula.

4. CONCLUSION

This systematic literature review identified four principal themes in effective adaptive curriculum development management: student needs analysis as the foundation of planning, teacher competence strengthening as the driver of implementation, application of Universal Design for Learning (UDL) principles as the curriculum design framework, and responsive evaluation and feedback mechanisms as the guardian of continuous improvement. The principal novelty of this study is the construction of the Integrative Conceptual Framework of Adaptive Curriculum Management (KIMKA), which connects these four components dynamically, non-linearly, and cyclically. Unlike prior studies that capture only one or two components in isolation, this framework positions student needs as a constant reference point, treats teachers as curriculum co-developers, and treats evaluation as a continuous reflective process rather than a terminal activity.

Within the Indonesian context, the KIMKA framework has direct relevance to the implementation of Kurikulum Merdeka, which foregrounds differentiation and flexibility. This study recommends: (1) developing contextual, professional-learning-community-based teacher training programs; (2) integrating UDL principles more explicitly into the national curriculum framework; and (3) strengthening the role of school principals as instructional leaders who facilitate a sustainable adaptive curriculum ecosystem.

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