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Deep Learning: Policies, Concepts, and Implementation in Senior High Schools in Indonesia

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Abstract

The transformation of education in the era of the Industrial Revolution 4.0 and Society 5.0 demands a more holistic, adaptive, and relevant learning approach aligned with the needs of the 21st century. One emerging approach is deep learning, which, in the educational context, does not refer to artificial intelligence technology, but rather to a learning paradigm that emphasizes deep understanding, critical thinking, collaboration, and the interconnection of cognitive, emotional, and social aspects. This study aims to examine the concept, implementation, and challenges of deep learning in Indonesian education through an analysis of theoretical literature and contextual empirical findings. The study identifies three key pillars that underpin the deep learning approach: mindful learning, meaningful learning, and joyful learning, which work synergistically to create a humanistic and transformative learning experience. The findings show that the implementation of deep learning contributes positively to improving students' learning motivation, engagement, and reflective thinking skills. Although national policies such as the Merdeka Curriculum have incorporated these principles, practical implementation still faces challenges, particularly concerning teacher competencies and resource availability. Therefore, strengthening educators' capacity and providing adequate learning infrastructure are crucial for the sustainable implementation of deep learning in Indonesia.

Keywords: deep learning, educational transformation, holistic learning, humanistic education, mindful learning, meaningful learning, joyful learning, transformative learning

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1. Introduction

Education in Indonesia is currently directed toward strengthening three main focus areas: literacy, numeracy, and writing skills as the foundation for human resource development (Anjarwati et al., 2022; Rahmawati et al., 2022). Schools are not only places of formal learning but also function as social institutions that internalize collective values within society (Nugroho et al., 2023; Ramawati et al., 2021). In this context, education plays a strategic role in shaping individuals to be disciplined and independent (Pramesiana et al., 2020).

The rapid advancement of technology and social change in the era of the Industrial Revolution 4.0 and Society 5.0 demands the education system to adapt its approach. Education can no longer rely solely on the transmission model of knowledge; it must instead foster critical, creative, communicative, and collaborative thinking skills. Unfortunately, the learning system in many Indonesian schools is still dominated by

a teacher-centered and rote memorization approach, which leads to low student engagement and a lack of relevance to real-life contexts (Suharyanto, 2020; Maulana et al., 2022).

To address these challenges, the Ministry of Basic and Secondary Education (Kemdikdasmen) has introduced a new paradigm known as the deep learning approach in education. Unlike deep learning in the context of artificial intelligence, this approach emphasizes meaningful, mindful, and joyful learning that touches on students' cognitive, affective, and social dimensions (Kadarismanto & Sari, 2025; Wahyudi, 2025). The core pillars of this approach—mindful learning, meaningful learning, and joyful learning—work synergistically to support character formation and the development of 21st-century life skills (Diputera & Zulpan, 2024; Otto et al., 2020; Putria et al., 2022).

However, the implementation of deep learning in educational institutions continues to face both structural and pedagogical challenges. Several studies indicate limited conceptual understanding among teachers, a lack of training opportunities, and curricular and administrative constraints (Rahmah & Sulaiman, 2021; Suwandi et al., 2024). As a result, integration of this approach remains suboptimal in practice and requires more applied and contextual research.

This study aims to comprehensively analyze the concept, policies, and practices of deep learning in Indonesian education. Its primary focus is on the integration of the three learning pillars (mindful, meaningful, joyful) into national education policies and their implementation strategies in schools. Specifically, the research seeks to address the following questions: (1) What is teachers' understanding of the deep learning concept? (2) What challenges do schools face in its implementation? (3) What strategies can optimize the integration of this approach into the education system?

The novelty of this study lies in its effort to bridge the gap between theory and practice through a holistic and transformative lens. It does not merely explore cognitive aspects or the use of media, but contributes to an integrative understanding that links pedagogy, policy, and classroom practice (Nurhasanah et al., 2020; Astuti, 2023). The findings of this study are expected to enrich academic literature and offer practical recommendations for teachers, policymakers, and curriculum developers.

This research is essential in strengthening the role of education in shaping a generation of learners who are reflective, collaborative, and resilient in the face of global challenges. Within the dynamic and multicultural context of Indonesian education, the deep learning approach can serve as a foundation for inclusive and relevant learning. This study is hoped to serve as a starting point for the development of more adaptive and sustainable 21st-century learning policies and strategies.

In the context of education, deep learning refers to a learning approach that enables students to construct meaningful understanding, integrate new knowledge with prior experiences, and apply their learning outcomes reflectively in real-life situations (Biggs & Tang, 2011; Mystakidis et al., 2021). This approach emphasizes higher-order thinking processes such as analysis, synthesis, evaluation, and creation, rather than mere memorization of surface-level information.

There are two main learning approaches: surface learning and deep learning. Surface learning occurs when students attempt to meet task requirements with minimal effort (Marton & Säljö, 1976), whereas deep learning encourages learners to comprehend the

underlying meaning of the material, relate it to prior knowledge, and apply it critically. Within the framework of constructivist learning theory, deep learning aligns with the principle that knowledge is actively constructed by individuals through experience and social interaction (Bruner, 1966; Vygotsky, 1978). Therefore, teachers serve as facilitators who create learning environments that enable the construction of meaning.

The *deep learning* approach in the Indonesian context is often integrated with three complementary core principles of learning:

a. Mindful Learning: Refers to learning that is carried out consciously, attentively, and reflectively. Ritchhart et al. (2011) argue that awareness in thinking (metacognition) forms the foundation of deep learning. Mindful learning also acknowledges the diversity of students' learning styles, backgrounds, and emotions, and encourages them to become active subjects in the learning process (Diputera & Zulpan, 2024).
b. Meaningful Learning: This approach enables learners to connect new material with personal experiences and real-life contexts. According to Ausubel (1968), meaningful learning occurs when new information is integrated into existing cognitive structures. Everyday life contexts play a crucial role in helping students grasp the relevance of the subject matter to the real world.
c. Joyful Learning: Emphasized by Otto et al. (2020) and Putria et al. (2022), joyful learning refers to instruction that takes place within a positive emotional atmosphere—one that is enjoyable and fosters students' intrinsic motivation. A supportive environment that encourages freedom of expression, creativity, and exploration is key to the success of this approach.

These three pillars cannot stand alone. Learning can only be considered *deep* when all three principles are present in balance, thereby shaping a holistic learning process.

Modern education requires students to possess the 21st-century skills of critical thinking, collaboration, creativity, and communication (4C), as outlined in the *Framework for 21st Century Learning* by P21 (Partnership for 21st Century Skills, 2019). *Deep learning* is considered one of the most relevant approaches for developing these skills, as it actively, reflectively, and contextually engages learners in the learning process.

Fullan and Langworthy (2014) introduced the concept of *New Pedagogies for Deep Learning* (NPDL), which encompasses six global competencies: character, collaboration, communication, creativity, critical thinking, and global citizenship. Within this framework, deep learning is not only a pedagogical strategy but also a systemic approach to preparing a generation of adaptive and meaningful learners.

In the Indonesian context, implementing deep learning must take into account local values and cultural diversity. Vygotsky's (1978) *Sociocultural Learning Theory* emphasizes that learning is inseparable from the social and cultural contexts in which students live. Therefore, deep learning should be designed using a contextual approach, linking instructional content to students' personal experiences, local values, and social realities. Contextual learning based on everyday life has been shown to enhance student engagement and understanding of the material (Rahmah & Sulaiman, 2021). At the same time, teachers are expected to act as agents of change—not

only mastering subject content, but also demonstrating cultural sensitivity and adaptive pedagogical skills.

In implementing deep learning, teachers no longer act as mere transmitters of information but as designers of learning experiences. According to Biggs and Tang (2011), teachers must be able to design challenging, authentic learning tasks that encourage critical thinking and reflection on the learning process.

Learning design models that support deep learning include:

[1] Problem-Based Learning (PBL)
[2] Project-Based Learning (PjBL)
[3] Inquiry-Based Learning
[4] Reflective Teaching

These models have been proven effective in building deep learning because they place students at the center of learning, actively involve them, and emphasize contextual processes and learning outcomes (Hmelo-Silver, 2004; Bell, 2010).

Based on the theoretical review above, the deep learning approach is a transformative learning strategy relevant to facing 21st-century educational challenges. This approach not only emphasizes cognitive aspects but also builds learning experiences that are mindful, meaningful, and joyful. In practice, deep learning demands an active role from teachers as facilitators who are sensitive to students' socio-cultural contexts and able to design problem-based learning. Therefore, comprehensive theoretical understanding of this approach is a crucial foundation to analyze and develop learning practices in Indonesia more effectively and sustainably.

Considering the various theories and approaches outlined, it can be concluded that deep learning in education is not merely a pedagogical strategy but a learning paradigm requiring integration of cognitive, affective, social, and cultural dimensions. Although models such as Problem-Based Learning or Project-Based Learning have been widely studied, research on how teachers interpret and integrate the pillars of mindful, meaningful, and joyful learning into classroom practice—especially in Indonesia's plural and diverse educational context—is still very limited (Anggarini et al., 2024). Hence, this theoretical understanding not only serves as a conceptual foundation but also reveals the need to explore its real implementation more deeply. This study uses these theories as a framework to analyze the extent to which school learning practices reflect deep learning values and to formulate more contextual and applicable pedagogical strategies.

2. Approach

This study employed a qualitative research approach through a systematic literature review and contextual analysis to explore the concept, implementation, and challenges of deep learning in Indonesian education. The research methodology consisted of two primary stages:

a. Theoretical Literature Review

The first stage involved an in-depth review of theoretical and conceptual literature related to deep learning in education, particularly focusing on its core principles such as mindful learning, meaningful learning, and joyful learning. Sources were selected from peer-reviewed journal articles, academic books, and policy documents published within the last ten years, ensuring both relevance and scholarly credibility. The selection criteria emphasized works that discuss the philosophical, pedagogical, and psychological foundations of deep learning in the context of 21st-century education.

b. Contextual Empirical Analysis

The second stage consisted of an interpretative analysis of empirical studies, national education policies (e.g., "Kurikulum Merdeka"), and educational reports specific to the Indonesian context. Data were collected from various open-access education databases, national policy portals, and reputable Indonesian journals. This step aimed to contextualize the theoretical insights within real-world practices, highlighting both the achievements and obstacles in implementing deep learning in schools.

The data from both stages were analyzed thematically, following a deductive-inductive coding process. Initial coding was guided by predetermined themes (mindful, meaningful, and joyful learning), which were then expanded inductively as new patterns and sub-themes emerged from the literature. This methodological framework enabled a comprehensive synthesis of theory and practice, allowing the researchers to derive critical insights and propose strategic directions for the advancement of deep learning in Indonesian education (Susanti et al., 2024).

3. Result and Discussion

Deep learning in the context of education does not merely refer to artificial intelligence but also to a learning approach that emphasizes deeper understanding, critical thinking skills, and strong problem-solving abilities. This approach seeks to go beyond conventional teaching methods that often rely on rote memorization by encouraging students to comprehend and apply their knowledge in various real-life situations, as well as to develop the ability to adapt and integrate knowledge across diverse contexts (Kadarismanto & Sari, 2025).

Deep learning also encompasses cognitive, social, and emotional dimensions that play a crucial role in the learning process. Students are encouraged to cultivate empathy, build meaningful relationships, and understand their social roles within the learning environment (Mystakidis et al., 2021). Emotional engagement and learning motivation are also prioritized, as interest in the subject matter has been shown to enhance active student participation (Otto et al., 2020). This is what distinguishes deep learning from traditional approaches, which often prioritize breadth of content coverage over depth of meaning.

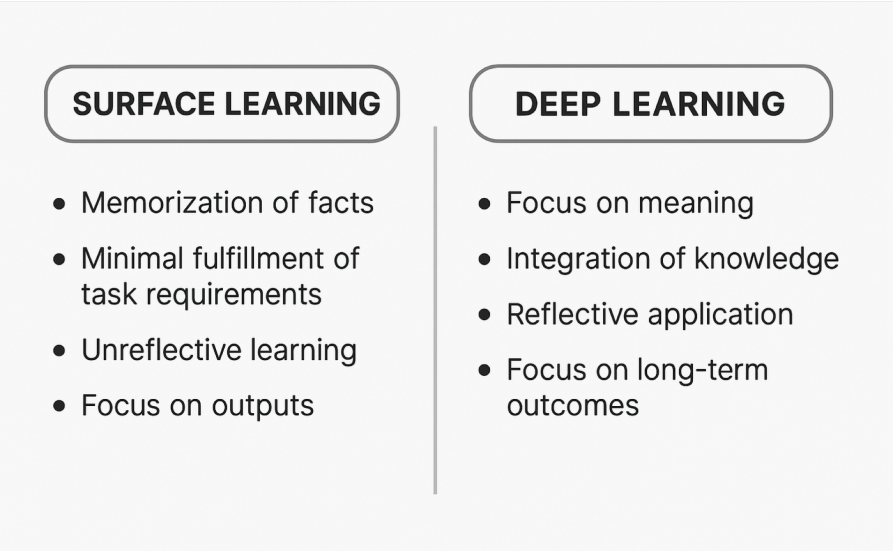

Figure 1. A Comparison between Surface Learning and Deep Learning

Figure 1 illustrates the comparison between surface learning and deep learning as two learning approaches with distinct orientations and significantly different impacts on the student learning process. Surface learning is characterized by superficial activities such as rote memorization of facts, minimal task completion, and a lack of reflection in understanding the material. This approach typically emerges in educational systems that are heavily exam-oriented and focused primarily on cognitive assessments, where students concentrate on outcomes rather than the learning process (Purwani et al., 2025).

In contrast, deep learning emphasizes meaning-making, the integration of new knowledge with prior understanding, and reflective application across real-life contexts. Students are not merely absorbing information; they are actively engaged in constructing deep understanding, thinking critically, and developing long-term problem-solving skills. This approach aligns with the 21st-century learning paradigm, which demands higher-order thinking competencies and lifelong learning. Through this visualization, readers are able to grasp the essential differences between these approaches, as well as the urgency of transforming teaching methods toward a more meaningful, reflective, and relevant deep learning model suited to current educational challenges.

In practice, deep learning requires students to critically analyze, connect new information with existing knowledge, and apply it in real-world situations. This nurtures lifelong learning motivation and the ability to adapt amid rapid global change. The approach is rooted in active, collaborative, and continuous learning, fostering a mindset of lifelong learners and aligning with educational policies that aim to prepare younger generations to be critical, creative, and adaptive to change (Santiani, 2025). Therefore, this approach serves as a vital foundation for 21st-century education that is both humanistic and transformative.The concept of deep learning in education is based on three main pillars: mindful learning, meaningful learning, and joyful learning. These three approaches complement each other to create a more holistic learning process by addressing the cognitive, emotional, and social aspects of students. Mindful learning emphasizes the importance of a deep understanding of the diverse characteristics, needs, and learning styles of each student. By acknowledging this diversity, learning can become more inclusive and foster the development of emotional intelligence. Mindful learning encourages students to be fully present in the learning process, enhancing their awareness of ongoing experiences and helping them connect more deeply with the material being studied and their social environment (Diputera & Zulpan, 2024).

Meanwhile, joyful learning focuses on creating enjoyable and stimulating learning experiences. A positive, creative, and non-pressuring learning environment has been shown to increase student participation and learning outcomes. When students feel happy and safe during the learning process, they tend to be more open to acquiring new knowledge and more confident in expressing their ideas. On the other hand, meaningful learning demands deep understanding by linking the subject matter to real-life situations, thereby making learning more relevant (Putria et al., 2022). By connecting lessons to real-world contexts, students can grasp the relevance of the material in their own lives, making the

meaning they derive deeper and more impactful. Table 1 below summarizes the conceptual pillars of the deep learning approach.

Table 1. Conceptual Pillars in the Deep Learning Approach.

Learning Approach	Definition	Main Objective	Implementation Characteristics
Mindful Learning	Learning that is conducted consciously, reflectively, and with full attention to the learning process	To cultivate self-awareness, metacognition, and empathy	Students are able to recognize their own learning styles, stay focused during learning, and reflect on their understanding
Meaningful Learning	A type of learning that connects the subject matter to real-life experiences or authentic contexts	To enhance the relevance of the material for students	Students can explain the relationship between the lesson and everyday life
Joyful Learning	Learning that occurs in a positive and enjoyable emotional atmosphere	To foster intrinsic motivation and active engagement	Students feel comfortable, interested, and actively involved in the learning process

Table 1 illustrates the three main pillars of the deep learning approach, namely mindful, meaningful, and joyful learning, which synergistically shape a holistic and student-centered learning process. Each pillar plays a strategic role in enhancing the quality of learning, addressing self-awareness, connection to real-life contexts, and students' intrinsic motivation. These three pillars emphasize that effective learning should not only target cognitive aspects but also engage affective and social domains, thereby supporting the development of character and 21st-century life skills.

The deep learning approach is also reflected in the innovative curriculum developed by Abdul Mu'ti, which emphasizes active, collaborative, and inquiry-based learning. Students are not merely passive recipients of information but are directly involved in meaningful exploration and discussion that positions them at the center of the learning process. This approach promotes competencies that play a crucial role in the 21st-century educational era (Muvid, 2024). The curriculum encourages students to become proactive and creative learners capable of overcoming challenges and adapting rapidly to changes in their surrounding world.

Figure 2. The Synergy of the Three Pillars of Deep Learning in Holistic Learning

Figure 2 above presents a visual representation of the synergy among the three main pillars of the deep learning approach, namely mindful learning, meaningful learning, and joyful learning. These are depicted as a triangle that mutually supports and surrounds the core concept of "deep learning," emphasizing that this approach is not one-dimensional but rather an integrated whole of these three aspects.

Mindful learning symbolizes the importance of full presence and self-awareness in the learning process. Students who engage in mindful learning are better able to recognize their thinking processes, reflect on their understanding, and appreciate their unique needs and characteristics. Meaningful learning illustrates the connection between the subject matter and the real-life context of students (Jayanti et al., 2021). Through this approach, students do not merely memorize information but understand its relevance and application in daily life. Meanwhile, joyful learning focuses on creating a positive and emotionally safe learning atmosphere. When students feel comfortable and interested, their intrinsic motivation increases.

This synergy is designed to reinforce the understanding that the success of deep learning can only be achieved through a synergistic combination of these three pillars. Thus, the synergy depicted in the figure not only represents a theoretical structure but also serves as a practical guide for teachers and curriculum designers in developing holistic, humanistic, and sustainable educational processes.

The deep learning approach has begun to be adopted in Indonesia's education policy as part of efforts to improve learning quality. In Indonesia, the government, through the Ministry of Education and Culture, strengthens this direction by implementing a deep learning model that emphasizes learning freedom and project-based learning. This approach places meaningful and mindful learning experiences at the core, making it relevant for application within the Indonesian educational context (Gumartifa et al., 2023). The Minister of Education has even stated that deep learning represents a new direction in national education policy aimed at fostering

critical thinking, collaborative skills, and student readiness to face future challenges.

Research conducted by Suwandi, Putri, and Sulastri (2024) on educational innovation in Indonesia using the deep learning model shows positive outcomes, particularly in increasing student activeness and engagement in the learning process. This is further supported by Wahyudi's (2025) study, which concludes that deep learning-based instruction significantly impacts the improvement of students' mathematical reasoning abilities and self-confidence, which directly influences their success in facing academic challenges.

Table 2. Impact of Deep Learning Implementation in Schools

Indicator	Before Deep Learning Implementation	After Deep Learning Implementation	Change (%)
Student Engagement	52% (less active in class)	75% (active in discussions and projects)	+23%
Reasoning Ability	Average score 64	Average score 88	+37.5%
Student Confidence	45% (passive and hesitant to speak)	76% (confident to express opinions)	+31%

Table 2 presents a quantitative overview of the impact of implementing the deep learning approach on the learning process and outcomes of students in schools. The three main indicators analyzed in this table are student engagement, reasoning ability, and self-confidence. Before the implementation of deep learning, most students showed low participation levels, were predominantly passive, and tended to experience difficulties in developing critical reasoning and self-confidence to actively participate in class discussions.

After the implementation of the deep learning-based learning model, there was a significant increase in all three aspects. Student engagement increased from 52% to 75%, indicating that students became more active in the learning process. Reasoning ability increased by 37.5%, suggesting that this approach helped students to understand the material more deeply and analytically. Meanwhile, self-confidence also rose by 31%, reflecting a more supportive and inclusive classroom atmosphere.

These data confirm that deep learning not only enhances cognitive achievement but also fosters a learning environment that supports students' affective and social growth. These findings strengthen the argument that deep learning is a transformative approach relevant to improving the overall quality of education.

Despite the many advantages of deep learning in education, several challenges need to be addressed. One of the main obstacles in Indonesia is the readiness of educators to adopt this method. Some teachers revealed that they are still accustomed to more traditional teaching methods and require additional training to implement deep learning more effectively. Moreover, limitations in resources and technological infrastructure, especially in regions lacking adequate access to technology, pose significant barriers to the implementation of this method (Kadarismanto & Sari, 2025).

Deep learning-based education has great potential to enhance the quality of education in Indonesia. However, a comprehensive transformation is required in teacher training, curriculum design, and infrastructure provision. The integration of the three pillars (mindful, meaningful, and joyful) must be

realized not only in curriculum documents but also in everyday classroom practices.

Policies supporting the sustainability of deep learning-based education need to consider local contextual differences, human resource capacities, and community participation within schools. If these challenges are overcome, this approach can serve as a transformative strategy in shaping a generation of reflective, creative, and resilient learners ready to face global challenges.

The implementation of the deep learning approach in the Indonesian educational context indeed promises a more meaningful, reflective, and humanistic transformation of learning (Adawiali et al, 2022). However, behind this positive potential lie various challenges that need to be identified and addressed to ensure optimal and sustainable implementation. Table 3 below presents some of the main challenges faced by schools in Indonesia in applying this approach.

Table 3. Challenges in Implementing Deep Learning in Indonesian Schools

Aspect	Main Challenges	Impact on Implementation	Suggested Solutions
Teacher Competence	Lack of training on project-based, reflective, and collaborative pedagogical strategies	Teachers tend to revert to traditional lecture methods	Intensive training, mentoring, teacher learning communities
Resources and Materials	Non-contextual teaching materials and limited ICT-based learning tools	Learning becomes less meaningful and student participation is minimal	Development of contextual learning media
Technology Infrastructure	Limited internet access and devices, especially in 3T (frontier, outermost, underdeveloped) areas	Hinders implementation of digital-based learning models	Gradual and inclusive provision of technology

This table shows that the challenges in implementing deep learning are multidimensional, covering human resources, learning materials, and technological infrastructure. The limitation of teacher competencies is a major issue, especially regarding the design of project-based or reflective learning that requires the teacher's role as a facilitator. On the other hand, many schools lack contextual teaching materials and ICT devices that support active learning. These challenges are even greater in the 3T areas (frontier, outermost, and underdeveloped regions) that still face limited access to technology.

To overcome these obstacles, policies are needed to systematically support teacher capacity development, the provision of contextual learning resources, and equitable technology investment. By strategically anticipating these challenges, the implementation of deep learning in Indonesia can proceed effectively and sustainably.

4. Conclusion

Based on the results of the theoretical review and empirical findings from this study, it can be concluded that the deep learning approach in Indonesian education is not merely a term related to artificial intelligence but rather a student-centered learning paradigm that promotes deep understanding, critical thinking, collaboration, and integration of cognitive, emotional, and social aspects. This approach aims to develop learner profiles that are reflective, adaptive, and competitive in the global era. The three main pillars—mindful learning, meaningful learning, and joyful learning—have been proven to complement each other in creating

a holistic and humanistic learning process. Mindful learning helps students engage actively and reflectively; meaningful learning fosters relevance and connection to real-life contexts; while joyful learning builds motivation and psychological comfort in learning. Indonesia's education policies have shown progressive advancement through the Merdeka Curriculum, which accommodates deep learning principles via project-based approaches, differentiated instruction, and teacher autonomy to adapt to local contexts. However, implementation in the field remains uneven due to teacher readiness, limited pedagogical training, and disparities in access to educational resources across regions.

This study also reveals that applying deep learning positively contributes to increasing learning motivation, active student engagement, and reflective and solution-oriented thinking skills, particularly in arts and culture education that integrates national values and creative expression. Nevertheless, significant challenges remain regarding teacher competencies and infrastructure support, which need to be addressed through strengthening practice-based training programs, professional mentoring, and affirmative policies for regions with limited access.

Thus, the deep learning approach holds great potential as a foundation for more meaningful and relevant educational transformation aligned with the demands of the 21st century, provided it is supported by systemic commitment from various policymakers and education stakeholders.

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