

A Critical Analysis of the Implementation of Deep Learning Policy at Elementary School Level in Indonesia

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Abstract

This study critically examines the implementation of Deep Learning policies at the elementary school level in Indonesia. This study analyzes the effectiveness of equity and governance strategies using the Systematic Literature Review (SLR) method with the PICOC framework on 27 reputable journal articles from 2024-2025 and the policy document of the Minister of Elementary and Secondary Education Regulation No. 13 of 2025. The main focus of this study is (1) Mapping the regulation and implementation of Deep Learning in education; (2) Identifying challenges and successes in holistic implementation; and (3) Compiling a synthesis of findings to recommend improvements in governance and equity of Deep Learning in national education policy. Based on the SLR results, it shows that the implementation of Deep Learning at the elementary school level in Indonesia has a policy foundation that carries a progressive pedagogical vision with an emphasis on conscious, meaningful, and joyful learning, as well as strengthening 21st-century competencies. However, its implementation faces challenges such as low teacher understanding and readiness, uneven implementation across elementary schools, and limited infrastructure and access to technology.

Keywords: policy, deep learning, elementary school, Indonesia



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Introduction

The global education world is undergoing a fundamental paradigm shift, shifting from a learning model focused on rote learning and one-way knowledge transmission to an approach that emphasizes mastery of 21st-century competencies (Ananiadou & Claro, 2009). In response to the challenges of the disruptive era, characterized by the rapid development of information technology and uncertainty, the concept of Deep Learning has emerged as a pedagogical response believed to prepare students for the complexities of future life (Fullan & Langworthy, 2014). Essentially, Deep Learning is not simply about deepening material, but rather a process in which students internalize knowledge and use it to create new solutions and add meaning to their world. This concept emphasizes the development of six core competencies (global competencies): character development, citizenship, collaboration, communication, creativity, and critical thinking (Fullan et al., 2018). This wave of global educational transformation has also driven and influenced educational policy initiatives in Indonesia, reflected in the latest curriculum policy, the Independent Curriculum (Kemendikbudmen, 2022). This curriculum, with its focus on differentiated learning and strengthening of the Graduate Profile Dimensions (DPL), demonstrates alignment of vision with the principles of Deep Learning in shaping the holistic capacity of learners.

In response to these global challenges, the Indonesian Government, through the Ministry of Primary and Secondary Education (Kemendikdasmen), has attempted to integrate Deep Learning principles into its core policy framework, particularly as manifested in the Independent Curriculum (Kemendikdasmen, 2022). Operationally, this curriculum is designed with an emphasis on differentiated learning that views student diversity as a gift, demanding authentic engagement and strengthening the Graduate Profile Dimensions as a foundation for character and competency (Rahmawati & Fatimah, 2023). This policy construct is essentially oriented toward achieving deep learning outcomes, which aligns with the Deep Learning vision of shaping students into adaptive and contributing lifelong learners (Fullan et al., 2018). However, behind this progressive policy narrative, a critical question inevitably arises: "Have the spirit and ideal design

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embodied in this policy document been implemented effectively and meaningfully at the most micro level, namely within the dynamics of the classroom?" This question suggests a possible gap between policy theory and actual practice on the ground, a phenomenon that frequently occurs in educational reform (Supriyanto & Kusmaningtyas, 2021).

However, in the context of implementation, there is a potential gap between the policy narrative at the macro level and the reality of learning practices at the micro (classroom) level. Several preliminary studies and field reports indicate a series of complex challenges in operationalizing this policy. Research by Pratama & Sari (2022) revealed that teachers' conceptual understanding of Deep Learning is often partial and limited to superficial aspects, such as technology use, without addressing the essence of pedagogical change. Another challenge that emerged was the high administrative burden, with teachers preoccupied with preparing learning tool documents rather than innovating the teaching and learning process (Wijaya et al., 2023). Furthermore, limited resources and supporting infrastructure, such as access to relevant teaching materials and classrooms conducive to collaboration, also pose significant obstacles (Fadilah et al., 2021). Furthermore, the deeply ingrained, conventional, teacher-centered learning culture in many educational units creates inertia that is difficult to shift toward a new paradigm (Novianti & Hidayat, 2020). This gap between policy expectations and reality is crucial for in-depth examination at the elementary school level. Elementary school is the foundational stage in the education ecosystem, where character development, social competencies, and student learning mindsets begin to be formed. Failure to implement in-depth learning at this stage has the potential to create a fragile foundation for competency development at subsequent levels (Zubaidah, 2019).

In the literature review related to Deep Learning in Indonesia, several studies have highlighted it using quantitative experimental and descriptive qualitative methods. While Sari & Dewi (2025) employed a descriptive qualitative method, the study focused on the development of Artificial Intelligence (AI) technology in Deep Learning. Riska et al. (2024) employed a non-SLR literature review method and focused on the perspectives of Deep Learning in relation to current educational innovations. Previous studies have identified shortcomings that constitute important gaps for further research. This study seeks to address these gaps by providing a detailed examination of Deep Learning policies and their implementation at the elementary school level in Indonesia, thus contributing to current research.

Basid on the background and gap identification above, a literature review was conducted to critically analyze the implementation policy of Deep Learning at the Elementary School Level in Indonesia. The main focus of this study is: (1) Mapping the regulation and implementation of Deep Learning education; (2) Identifying the challenges and successes of implementation holistically; and (3) Compiling a synthesis of findings to formulate recommendations for improving the governance and equity of Deep Learning in national education policy. In addition, another objective of this SLR study is to provide recommendations for policymakers and curriculum developers so that these findings can serve as a basis for evaluation in developing more contextual implementation guidelines and taking into account real conditions in the field (Rahmawati & Fatimah, 2023). Meanwhile, for education practitioners, especially teachers and principals, the results of this study can reflect best practices and become material for introspection to improve the quality of instructional design and pedagogical interactions, which ultimately lead to the creation of more impactful and meaningful learning for students (Fullan et al., 2018).

Method

This research uses the Systematic Literature Review (SLR) method. A systematic literature review (SLR) is a structured research approach to explore, critically evaluate, synthesize, and present the results of various studies related to a specific question or topic. It is called "systematic" because the process follows consistent procedures and is widely recognized in scientific practice (Pati & Lorusso, 2018). In research activities, SLR uses secondary data from various library studies or literature relevant to the research problem, sourced from books, articles, or relevant journals (Adi et al., 2020).

The stages of SLR implementation are as follows:

- a. Formulating research questions (Research Questions–RQ).
- b. Determining inclusion and exclusion criteria.
- c. Literature search strategy
- d. Literature selection based on original empirical research articles or research articles containing the results of actual observations or experiments, including an abstract, introduction, methods, results, and discussion of the research.
- e. Data extraction including author identity, title, year, country, findings, study setting, and challenges.
- f. Data synthesis
- g. Reporting of Results

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Formulating Questions

The PICOC (Population, Intervention, Comparison, Outcome, Context) framework is used to maintain a clear and directed research focus. Each component of the PICOC is designed to help formulate appropriate research questions, guide the literature search, and direct the data analysis process (Petticrew & Roberts, 2006).

Table 1. PICOC Matrix of Research

Elemen PICOC	Dskripsi Rinci	Relevansi dengan Penelitian
<i>Population (P)</i>	Educational institutions in Indonesia Elementary School	Determine the unit of analysis in the form of the national education ecosystem impacted by the deep learning policy.
<i>Intervention (I)</i>	Deep Learning Policy from Permendikdasmen No. 13 of 2025	It is the main variable whose influence on the governance and quality of education is studied.
<i>Comparison (C)</i>	Implementation of Deep Learning at elementary school level	To be a comparison to assess the effectiveness of Deep Learning policies at the elementary school level.
<i>Outcome (O)</i>	Improving teacher competency regarding Deep Learning, effectiveness of Deep Learning learning for elementary school students, identification of gaps and obstacles in implementing Deep Learning.	To be an indicator to assess the success and obstacles of implementing Deep Learning policies in Indonesia at the elementary school level.
<i>Context (C)</i>	Implementation of Deep Learning at elementary school level in Indonesia (2024-2025).	Providing context and time period limitations.

Sumber: Penulis

Based on the PICOC framework above, the research questions that form the focus of this SLR are as follows:

RQ 1: How is the implementation of the Deep Learning policy at the elementary school level in Indonesia?

RQ 2: How significant is the impact of the implementation of the Deep Learning policy at the elementary school level in Indonesia?

RQ 3: What are the challenges of implementing the Deep Learning policy on teacher understanding, teacher readiness, and infrastructure in Indonesia?

Determining Inclusion and Exclusion Criteria

The inclusion criteria for this study were: 1) Deep Learning policy, 2) implementation of Deep Learning in learning, 3) focus on elementary school level, 4) location in Indonesia, and 5) publication year 2024-2025. Anything other than the inclusion criteria also falls within the exclusion criteria.

Literature Search Strategy

Literature search was conducted through several sources from the Watase Uake database, Science Direct and Google scholar with the search keywords deep learning policy, elementary education (elementary school-PGSD students), Indonesia.

Literature Selection

The literature selection process was conducted systematically to ensure that only relevant, high-quality articles aligned with the research focus on Deep Learning policy at the Elementary School Level in Indonesia were included. The literature selection process was conducted through data sources from Watase Uake, Science Direct, and Google Scholar using the keywords "Deep Learning Policy at All Levels of Education in Indonesia" OR "Deep Learning in Indonesia" OR "Deep Learning Policy at Elementary School." The mapping analysis procedure based on PRISMA provisions is shown in Figure 1.

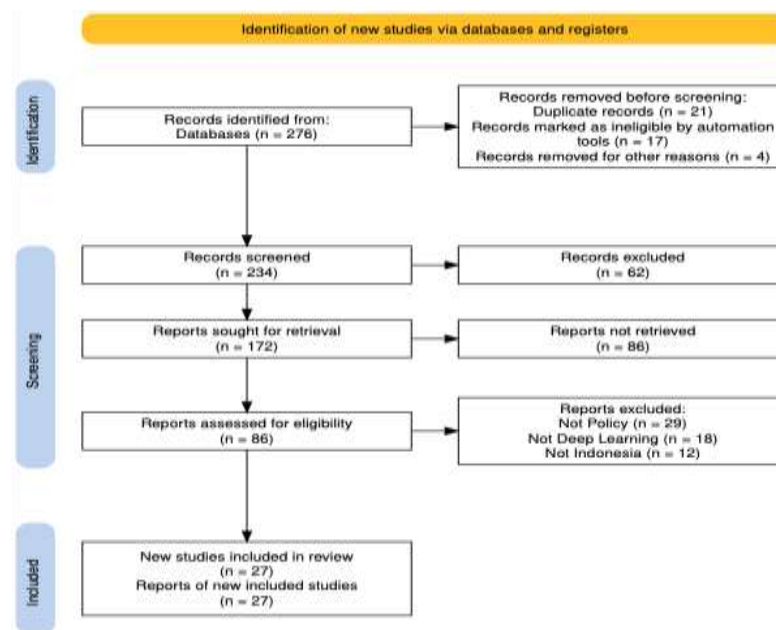


Figure 1. PRISMA Flowchart

Based on Figure 1, the initial data identified 276 articles, both national and international. From this initial data, 21 articles were duplicated, 17 records were marked as ineligible by the automation tool, and 4 records were removed for other reasons. After the filtering process, 234 records remained to be processed. However, 62 records were excluded from this analysis. A total of 172 articles were searched for retrieval, but only 86 were deemed eligible for inclusion in the analysis. Further filtering of the assessed articles was performed. A total of 29 articles did not match the policy keywords, 18 articles did not match (deep learning), and 12 articles were not in Indonesia. Finally, the final result of this research analysis was 27 articles included in this study.

Data Extraction

The extraction process aims to ensure that all relevant data related to Deep Learning policies at the elementary school level in Indonesia can be thoroughly analyzed. The extracted data includes author identity, year, title, findings, study setting, and challenges. The extracted data for 27 articles is included in the appendix of this article.

Data Synthesis

The data synthesis stage was conducted to integrate the findings from 27 selected articles to obtain a comprehensive understanding of the implementation of Deep Learning policies at the elementary school level, the impact of Deep Learning policy implementation at the elementary school level, and the challenges of Deep Learning policy implementation on teacher understanding, teacher readiness, and infrastructure in Indonesia. The synthesis process was carried out using a thematic approach, namely grouping research results based on the main focus of the study, then comparing similarities, differences, and trends in policy patterns that emerged in the 2024–2025 period. Based on the results of data extraction, the synthesis can be divided into three major themes that correspond to the following research questions (RQ).

RQ 1. Implementation of Deep Learning Policy at Elementary School Level in Indonesia

Deep Learning Policy: Learning that focuses on deep understanding, so that students are encouraged not only to memorize but also to deeply understand concepts, connect ideas, analyze, evaluate, and create, and transfer knowledge to new contexts. Furthermore, Mindful Learning: Learning must encourage students to reflect on their own learning process according to their individual characteristics and competencies. Meaningful Learning: Learning requires solving real-world problems, contextual projects, and exploring experiences related to everyday life. Joyful Learning: Learning must inspire enthusiasm, reduce student stress, create positive interactions, and teachers must be able to facilitate student creativity. Deep Learning should produce students with the 6Cs of Character, Citizenship, Collaboration, Communication, Creativity, and Critical Thinking. Most of the extracted articles explain that learning at the elementary school level has not fully implemented Deep Learning because teachers have limited understanding of Deep Learning and often equate it with the use of technology or active learning.

RQ 2. Impact of Deep Learning Policy Implementation in Elementary Schools in Indonesia

The Deep Learning approach is not only related to the use of technology, but also includes the integration of various learning strategies that require active student involvement in the learning process (Hasanah & Pujiati, 2025). One positive outcome of this policy is improved student literacy and numeracy skills through a more in-depth learning process that is relevant to life contexts (Warsidah et al., 2022). Research findings indicate that learning models that encourage active interaction between teachers and students can strengthen student understanding of the material while developing analytical thinking skills (Hasanah & Pujiati, 2025). A study at Cipondoh Elementary School also revealed that the formation of a collaborative learning community between teachers and students plays a crucial role in the successful implementation of Deep Learning, particularly in fostering critical thinking skills (Hadi, 2025).

RQ 3. Challenges of Implementing Deep Learning Policy in Indonesia

The implementation of Deep Learning faces various risks and challenges. Various studies indicate that several regions in Indonesia still lack adequate internet access, even though network availability is a crucial prerequisite for developing Deep Learning-based initiatives, including distance learning during the COVID-19 pandemic (Harta et al., 2024). In this context, Harta et al. (2024) emphasized the shift from traditional learning patterns to distance learning policies, which in practice face numerous obstacles, particularly in areas with limited facilities. The various policies implemented in response to this emergency have not fully guaranteed equitable access to education for all students.

A further obstacle is the weak integration of policies with stakeholders, which has the potential to thwart the achievement of policy objectives. Several studies emphasize the importance of increasing public participation in the decision-making process to ensure comprehensive acceptance and implementation of policies (Tyaningrum et al., 2025). The lack of clarity in direction and coordination in this integration risks creating a crisis of trust between the government and the public, ultimately hampering the effectiveness of policy implementation (Andriyana & Jowono, 2022).

Results and Discussion

Policy Mapping and Implementation of Deep Learning Policy in Indonesia

Literature analysis reveals the existence of policies and governance within the independent curriculum based on Deep Learning. Regarding policy governance, Ministerial Regulation No. 13 of 2025 regulates amendments to Ministerial Regulation No. 12 of 2024 concerning the curriculum for Early Childhood Education, Elementary Education, and Secondary Education. The main substance of this policy lies in strengthening the basic curriculum framework through a Deep Learning approach as the primary pedagogical approach. This policy establishes a new direction for the implementation of elementary and secondary education by emphasizing deep learning (conscious, meaningful, and joyful) as the principle of the current independent curriculum. The policy emphasizes that the learning process must be oriented towards critical reasoning, creativity, independence, collaboration, and the meaning of learning experiences, as well as six dimensions of the graduate profile within the deep learning framework: character, global citizenship, collaboration, communication, creativity, and critical thinking.

This policy strengthens the curriculum structure through adjustments to learning outcomes, teaching modules, and the use of digital technology, thus clearly implying a pedagogical vision for implementation in the elementary school curriculum. Article 32A of Law No. 13 of 2025 introduces a significant update, establishing that coding and artificial intelligence (AI) will be elective subjects for primary and secondary education, starting in 2025-2026. This policy is a strategic step to introduce digital literacy from elementary school on the path to a Golden Indonesia 2045.

Challenges and Successes of Deep Learning Policy in Indonesia

Based on the results of a systematic review of the literature, the results of the implementation of Deep Learning in many studies show that teachers' understanding of Deep Learning is still low, even still considering Deep Learning only limited to the use of technology, digital media or ordinary project-based learning, as evidenced by the explanation from Rahayu (2025) that teachers are confused about differentiating Deep Learning from the independent curriculum, then the explanation from Nurhidayati (2025) Hafifah (2025) stated that 65% of teachers out of 120 elementary school teachers faced difficulties in implementing deep learning even though socialization had been carried out. This is also influenced by the teacher's lack of readiness in implementing Deep Learning. Because Deep Learning requires teachers who are able to direct deep conceptual understanding, encourage reflection, argumentation, collaboration, and facilitate high-level problem solving. Many teachers still have a rote mindset and are not learning designers so they are still knowledge transmitters (Hendrianty, 2024). Furthermore, several studies also state that many teachers only apply "active learning", not mindful-meaningful-joyful learning according to the definition of Deep Learning. This shows that the core competencies of Deep Learning have not been embedded.

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The reason teachers' understanding of Deep Learning remains low and their preparedness inadequate is due to inconsistent and non-systemic implementation. This is because school culture, principal policies, collaboration within the Teachers' Working Group (KKG), and support for learning tools must align with deep learning policies. However, many schools only implement Deep Learning partially, with only certain teachers participating in the program, and there is no supervision or monitoring of implementation quality at the city education office level (Hidayat, 2025). This indicates that deep learning is not implemented as a learning ecosystem in schools, but is implemented only in certain classrooms.

Furthermore, another reality, based on numerous studies, states that a major obstacle to the implementation of Deep Learning is inadequate infrastructure in Indonesia, such as internet access, a lack of learning devices or media, unstable electricity in rural areas, and schools lacking AI-supporting devices to implement Deep Learning. Manik's (2025) research states that 45% of elementary schools are hampered by infrastructure, and other studies confirm the digital divide between rural and urban areas (Arianti, 2025; Yani Lubis, 2024). This shows that Deep Learning cannot run optimally without adequate infrastructure.

In the education sector, technology-based Deep Learning has the potential to transform teaching and learning methods. This method facilitates the implementation of more interactive, innovation-based learning strategies. For example, research by Zhao et al. demonstrates how AI and Deep Learning-based pedagogy can improve student motivation and learning abilities through a more personalized and adaptive approach (Zhao et al., 2022). The integration of technology in education also facilitates the development of learning systems that are more responsive to student needs, such as the use of Deep Learning-powered chatbots to answer student questions in higher education (Windiatmoko et al., 2021).

Despite the challenges, the implementation of Deep Learning at the elementary school level in Indonesia has shown some tangible success, although it is not evenly distributed. Several studies report that Deep Learning-based learning can improve students' conceptual understanding, strengthen critical thinking skills, and encourage active and reflective engagement in the learning process. This success is particularly evident in classes or schools that have integrated contextual learning, meaningful projects, and strategies that emphasize reflection and problem-solving, rather than mere memorization.

Furthermore, Deep Learning has been shown to positively impact character development and 21st-century competencies, such as collaboration, communication, creativity, and independent learning, in line with the Pancasila student profile. Several studies have shown that the use of supporting technologies, including adaptive educational games and limited AI utilization, can increase student motivation and literacy, and reduce the learning achievement gap, particularly for students from low socioeconomic backgrounds or inclusive students.

Another success is evident in the aspect of teacher professional development, particularly when Deep Learning is supported by teacher learning communities, collaborative-based training (KKG), and ongoing mentoring. In this context, teachers begin to transform from mere presenters of material to more reflective and student-centered learning designers. Overall, this SLR demonstrates that Deep Learning has significant potential to improve the quality of learning in Indonesian elementary schools. However, this success generally occurs in the context of planned implementation, supported by school policies, teacher readiness, and adequate infrastructure, and therefore cannot yet be generalized nationally.

Overall, although Indonesia still faces complex challenges in implementing Deep Learning policies, these policies demonstrate significant potential for development. To support the long-term success of Deep Learning policies in Indonesia, collaborative efforts involving various stakeholders, including the government, the private sector, and educational institutions, are needed to address existing challenges and optimize technical success. Indonesia can maximize Deep Learning's potential to improve the quality of education in Indonesia. Furthermore, clarity of policy direction and increased public involvement in the decision-making process are key factors in supporting the successful implementation of Deep Learning policies in the future.

Recommendations for Improving Governance and Equitable Distribution of Deep Learning in Indonesia based on a synthesis of findings from 27 articles, the implementation of Deep Learning policies in Indonesia faces various challenges, as explained above. Therefore, the policy recommendations formulated in this study need to be directed at strengthening systemic, integrated, and sustainable implementation, rather than merely conceptual socialization, so that the policies formulated in Permendikdasmen No. 13 of 2025 can be effectively implemented in the field. The explanation is as follows.

First, the government needs to design a tiered and sustainable, practice-based teacher professional development program, focusing on strengthening teachers as learning designers, not just technology users. Deep Learning training should emphasize in-depth pedagogical understanding, such as developing critical reasoning, reflection, argumentation, collaboration, and problem-solving skills for elementary school students, along with ongoing mentoring through Teacher Working Groups (KKG) and consistent academic supervision at the school level and throughout the education office.

Second, policy governance must be implemented holistically by strengthening the roles of schools and local governments. The implementation of Deep Learning policies in Indonesia should be implemented as a school culture, not as an individual teacher practice. This requires the active involvement of school principals in aligning school culture, school policies, lesson planning, and strengthening teacher collaboration. Local governments need to develop mechanisms for monitoring and evaluating the quality of Deep Learning implementation, so that implementation is not partial and symbolic, but truly reflects the principles of mindful, meaningful, and joyful learning as mandated by Permendikdasmen No. 13 of 2025.

Third, equitable distribution of educational infrastructure must be a top priority to support the success of Deep Learning, particularly in rural and underdeveloped areas (3T). The government needs to ensure the availability of stable internet access, digital learning tools, and AI-enabled technology, gradually and proportionally, according to regional conditions. Without adequate infrastructure support, Deep Learning implementation risks being limited to schools in urban areas, thus widening the gap in education quality.

Fourth, synergy across stakeholders, including the central government, local governments, the private sector, and the community, is needed to support the sustainability of Deep Learning policies. This collaboration can be realized through partnerships in educational technology development, school mentoring, and parental and community involvement in creating learning environments that support deep learning. Furthermore, clear policy direction and effective public communication are also crucial to ensure that Deep Learning is not misunderstood as a mere technological trend, but rather as a long-term pedagogical transformation.

Overall, improving the governance and equity of Deep Learning in Indonesia requires a holistic, adaptive, and equity-oriented approach to education. By strengthening teacher capacity, consistent policy implementation, equitable infrastructure, and cross-sector collaboration, Deep Learning has the potential to become a strategic instrument for improving the quality of basic education and preparing a generation of Indonesians with critical thinking, creativity, and character, in line with the vision of Golden Indonesia 2045.

Conclusion

Based on the literature review and policy analysis, it can be concluded that the implementation of Deep Learning at the elementary school level in Indonesia has a strong policy foundation through Ministerial Regulation No. 13 of 2025, which explicitly places deep learning as a central principle of the Independent Curriculum. This policy carries a progressive pedagogical vision by emphasizing conscious, meaningful, and enjoyable learning, as well as strengthening 21st-century competencies and graduate profiles. However, empirical findings indicate a clear gap between policy direction and practice in the field. The implementation of Deep Learning still faces serious challenges, particularly low teacher understanding and readiness, uneven and uncoordinated implementation at the school level, and limited infrastructure and technology access, particularly in rural and underdeveloped areas (3T). These conditions cause Deep Learning to often be practiced partially and not fully reflect the essence of deep learning as intended in the policy. Therefore, the successful implementation of Deep Learning in Indonesia is highly dependent on strengthening educational governance, continuously improving teacher capacity, equitable infrastructure, and cross-stakeholder collaboration so that the formulated policies can be implemented effectively and fairly across all basic education units.

Acknowledgment

The author expresses his deepest appreciation to all parties who have supported the completion of this article. He also thanks the researchers and academics whose work served as primary references in this study, as well as the institution where he works for providing facilities and a conducive academic environment. He also thanks the lecturers in the policy analysis and governance course who provided valuable input during the writing and refinement of the manuscript. He hopes that this small contribution will enrich scientific studies and encourage further research in the field of education.

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