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Mapping Deep Learning Quality in Senior High Schools Adopting the Deep Learning, Coding & Artificial Intelligence (DLCAAI) Model in Central Java as a Foundation for Evidence-Based Educational Policy

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Abstract
Educational transformation in the era of artificial intelligence necessitates that schools build a humanistic-digital, reflective, collaborative, and data-based learning ecosystem. This study aims to map the implementation quality of deep learning in State Senior High Schools adopting the Deep Learning, Coding & Artificial Intelligence (DLCAAI) model in Central Java and formulate its implications for evidence-based policy development (baseline assessment), involving 316 teachers from all DLCAAI model schools in the region. The research instrument was a five-point Likert scale questionnaire with 75 items covering dimensions of deep learning principles, learning experiences, deep learning framework, graduate profiles, and learning assessment. Validity tests showed all items were valid (corrected item-total correlation > 0.30), while instrument reliability was very high (Cronbach's Alpha = 0.992). Data analysis employed means, percentages, categories, and comparative dimensional analysis. Results indicate that deep learning implementation quality is at 93.43%. The strongest dimensions include student-centered learning, psychological safety, character development, inclusivity, and digital integration. However, metacognitive reflection, formative assessment, learning differentiation, cross-disciplinary learning, and the utilization of learning data still require strengthening. The novelty of this research lies in developing the Baseline Architecture of Humanistic-Digital Deep Learning Ecosystem framework, which integrates deep learning, AI, reflective pedagogy, student agency, and evidence-based educational policy. This study confirms that baseline assessment functions as an educational diagnosis, school transformation compass, and policy navigation system in the humanistic and sustainable AI-based educational transformation.

Keywords
baseline assessment; deep learning; DLCAAI; humanistic-digital learning ecosystem; evidence-based educational policy; artificial intelligence.

INTRODUCTION

The rapid development of the Society 5.0 digital transformation has fundamentally reconstructed the global educational landscape. 21st-century education must be transformative, reflective, and adaptable; therefore, students need to be prepared to create new value, solve complex problems, and make responsible decisions in an uncertain world (Fullan et al., 2020; OECD, 2023).

The development of generative AI has further accelerated the paradigm shift in learning, assessment, and pedagogical interaction. AI opens

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opportunities for developing personalized learning, adaptive assessment, learning analytics, and digital-based collaborative learning environments (Holmes et al., 2022). However, AI integration also presents serious challenges, including the emergence of superficial learning, technology dependence, declining critical reflection, and the potential for the dehumanization of education if implementation is not built on a solid pedagogical foundation (Selwyn, 2022). Consequently, UNESCO (2023) emphasizes that AI-based educational transformation must remain grounded in humanistic values, inclusivity, ethical awareness, sustainability, and meaningful learning.

In this context, education cannot be reduced merely to school digitalization. Schools need to build an adaptive, reflective, collaborative, and student-centered humanistic-digital learning ecosystem. The future quality of education is determined by the school's ability to create meaningful, contextual, transformative, and reflective learning experiences, not solely by technology availability. As a response to these challenges, deep learning has emerged as a strategic educational paradigm for the 21st century. Deep learning transcends memorization and information transfer by emphasizing conceptual understanding, critical reflection, authentic problem-solving, knowledge transfer, and transformative learning experiences (Fullan et al., 2020). It positions students as active subjects who construct knowledge through reflection, collaboration, inquiry, and contextualization. These are key characteristics of deep learning in connecting cognitive knowledge, the reality of social problems, and previous learning outcomes (Hattie, 2023). Furthermore, reflective learning plays a crucial role in strengthening metacognitive awareness, self-evaluation, and the reconstruction of student understanding. Mezirow (2020) affirms that transformative learning occurs through critical reflection, enabling individuals to build new perspectives on their learning experiences.

Another important dimension is student agency, i.e., the capacity of students to influence their learning process through choice, voice, responsibility, and ownership of learning (OECD, 2023). Agency-based learning environments have been proven to enhance student motivation, creativity, adaptive capacity, and collaboration (Darling-Hammond et al., 2020). From the perspective of deep learning, this is closely related to transformative learning and human-centered pedagogy, which emphasize empathetic pedagogical relationships, psychological safety, student well-being, and holistic human development (Noddings, 2021).

In Indonesia, educational transformation is accelerating through the implementation of the Merdeka Curriculum and the Deep Learning, Coding, and Artificial Intelligence (DLCAAI) policy. This policy represents reflective, differentiated, and student-centered learning. DLCAAI positions deep learning, reflective assessment, computational thinking, coding, and AI as strategic foundations for future education. The Deep Learning

Guidelines (Kemendikdasmen, 2025) affirm that learning should create conscious, meaningful, and joyful learning experiences through the holistic integration of cognitive, emotional, social, ethical, and physical dimensions.

DLCAAI also encourages differentiated learning and reflective assessment to strengthen metacognition, learning independence, and respect for student diversity. The integration of coding and AI is not merely positioned as a technological tool but as a pedagogical instrument to support creativity, inquiry, collaboration, and learning reflection. Thus, DLCAAI becomes part of building a broader humanistic-digital learning ecosystem.

Despite various educational reforms, learning practices in many Indonesian schools still face serious challenges. Learning is often dominated by surface learning, administrative culture, and short-term academic orientation. The focus tends to be on completing materials and exam preparation rather than strengthening critical reflection, authentic problem-solving, and metacognitive development. Furthermore, the practices of reflection, self-assessment, feedback utilization, and formative assessment have not been optimally implemented in classrooms (Black & Wiliam, 2021).

Initial findings from DLCAAI model schools in Central Java indicate that while schools have achieved good results in aspects such as inclusivity, student-centered learning, and digital integration, several dimensions still require strengthening, especially metacognitive reflection, formative assessment, conceptual connection, and cross-disciplinary learning. AI integration has not been fully utilized to support reflective pedagogy and inquiry-based learning but is still predominantly used for administrative needs and content delivery. This situation indicates that educational transformation requires pedagogical, cultural, and systemic changes based on empirical data. In this context, baseline assessment plays a strategic role as an educational diagnostic instrument to map learning quality, school culture, teacher capacity, and student learning experiences. Datnow and Park (2021) affirm that evidence-based educational quality improvement depends on the ability of schools and policymakers to utilize authentic data for intervention, evaluation, and continuous improvement.

However, research on the quality of deep learning in DLCAAI model schools in Indonesia is still very limited. Most studies focus more on digital technology adoption rather than the integration of reflective pedagogy, student agency, humanistic learning, and evidence-based educational policy within a single, coherent conceptual framework. Therefore, this study attempts to fill the theoretical and empirical gap by developing a baseline assessment framework for deep learning quality based on DLCAAI, integrated with an evidence-based educational policy approach. The novelty lies in developing the concept of a humanistic-digital learning ecosystem that integrates deep learning, AI, reflective pedagogy, student agency, formative assessment,

and data-based educational transformation as a foundation for strengthening Indonesian education in the age of artificial intelligence. This research is directed to answer the following questions: (1) What is the profile of deep learning quality in DLCAAI schools? (2) Which dimensions are strengths and development priorities? (3) How can baseline assessment support the development of evidence-based educational policy? Therefore, the objectives of this study are: (1) to map the implementation quality of deep learning in State Senior High Schools adopting the DLCAAI model in Central Java; (2) to analyze priority areas for pedagogical strengthening and quality improvement; and (3) to build a foundation for evidence-based educational policy through baseline assessment findings.

RESEARCH METHOD

A. Profile of Deep Learning Quality

The baseline assessment results from teachers at State Senior High Schools adopting the DLCAAI model in Central Java indicate that the quality of deep learning implementation is in the very good category. Based on valid data from 316 teachers, the total mean score was 350.38 out of a maximum score of 375, with a mean per indicator of 4.67 out of a scale of 5. The achievement percentage for deep learning implementation reached 93.43%, thus generally categorized as very good (Table 1). Descriptively, this finding indicates that DLCAAI model schools in Central Java have a strong pedagogical foundation in implementing deep learning. Teachers generally demonstrate learning practices that are purposeful, inclusive, contextual, collaborative, digital, joyful, and based on learning assessment.

Table 1. Profile of Deep Learning Quality in DLCAAI Model Schools, Central Java

Aspect	Result
Number of Valid Respondents	316 teachers
Maximum Score	375
Total Mean Score	350.38
Mean per Indicator	4.67 out of 5
Achievement Percentage	93.43%
General Category	Very Good

This data shows that the learning transformation in DLCAAI model schools is no longer at the concept introduction stage but has entered the stage of strengthening the quality of pedagogical practice based on deep learning, consistent with Fullan et al. (2020), who state that deep learning develops critical thinking, creativity, collaboration, communication, and character through authentic learning experiences. This finding indicates that DLCAAI schools in Central Java show strong readiness to build a humanistic, reflective, collaborative, and adaptive learning ecosystem for educational transformation in the era of AI, which is a primary need for building students' future competencies (OECD, 2023).

B. Findings Based on Deep Learning Dimensions

Dimension-based analysis shows the highest achievement was in the dimension of joyful and psychologically safe learning (mean = 4.75). The next dimensions were student-centered

learning and inclusivity (mean = 4.73), mindful learning (mean = 4.71), graduate profile/21st-century character (mean = 4.70), and digital integration and learning resources (mean = 4.68) (Table 2).

Table 2. Deep Learning Dimension Achievements

Dimension	Mean
Joyful and psychologically safe learning	4.75
Student-centered learning and inclusivity	4.73
Mindful learning	4.71
Graduate profile/21st-century character	4.70
Digital integration and learning resources	4.68
Formative assessment and feedback	4.63
Application experience	4.61
Reflection experience	4.58

The highest achievements in psychological safety, inclusivity, student agency, character, and digital integration indicate that model schools are moving towards a humanistic learning ecosystem. Schools are not only developing active learning but also building a classroom climate that supports courage to ask questions, appreciation of student effort, fair participation, and humanistic pedagogical relationships. Hattie (2023) affirms that psychologically safe learning environments have a significant influence on student engagement and learning success. This finding also indicates the development of reflective pedagogy and collaborative deep learning. Teachers are beginning to facilitate learning that provides space for collaboration, student dialogue, technology use, and more contextual learning experiences. Thus, DLCAAI model schools are showing a direction of transformation from conventional learning towards deeper, more participatory, reflective, and student-centered learning. UNESCO (2023) emphasizes that future learning must integrate technology with a humanistic approach so that education remains oriented towards holistic human development.

C. Dimensions with Relatively Lower Achievement

Although deep learning is occurring, several dimensions had relatively lower means compared to others. The reflection experience dimension had a mean of 4.58, application experience 4.61, and formative assessment and feedback 4.63. Furthermore, priority indicators for strengthening include the teacher's ability to facilitate students in making learning improvement plans, students assessing the strengths and weaknesses of their work, the use of initial assessment, utilization of local Central Java potential, and cross-disciplinary learning (Table 3).

Table 3. Priority Indicators for Strengthening

No. Item	Indicator	Mean
28	Teacher facilitates students in making learning improvement plans	4,53
27	Students assess strengths and weaknesses of their own work	4,54
67	Teacher uses initial assessment to understand student readiness	4,56

40	Learning utilizes local potential/culture/issues of Central Java	4,57
24	Teacher facilitates cross-disciplinary knowledge	4,57

These findings indicate that pedagogical transformation has not yet fully moved towards data-driven, adaptive, and personalized learning. Learning is already active, joyful, and inclusive, but still requires strengthening in metacognitive reflection, diagnostic assessment, learning differentiation, problem-solving using data, and building data-based reflection. According to Black and Wiliam (2021), effective formative assessment can improve learning quality when used as a basis for reflection and learning follow-up. Thus, the priority development area is no longer merely increasing learning activities, but deepening the quality of student thinking through metacognitive learning, placing reflection at the core of deep learning (Zimmerman, 2020). Schools need to strengthen students' ability to evaluate their learning process, make improvement plans, connect learning experiences with real-world contexts, and use feedback as a basis for continuous improvement.

D. Comparative Analysis Between Schools and Dimensions

Comparative analysis between schools shows that all DLCAAI model schools in Central Java are in the high to very high category. SMA Negeri 2 Purwokerto had the highest mean score (4.76), followed by SMA Negeri 1 Surakarta (4.72), SMA Negeri 1 Klaten and SMA Negeri 1 Jepara (4.68 each), SMA Negeri 1 Kartasura (4.64), SMA Negeri 5 Semarang (4.63), SMA Negeri 3 Semarang (4.60), and SMA Negeri 1 Demak (4.58) (Table 4).

Table 4. School-Based Achievements

School	Mean Score/Item
SMA Negeri 2 Purwokerto	4.76
SMA Negeri 1 Surakarta	4.72
SMA Negeri 1 Klaten	4.68
SMA Negeri 1 Jepara	4.68
SMA Negeri 1 Kartasura	4.64
SMA Negeri 5 Semarang	4.63
SMA Negeri 3 Semarang	4.60
SMA Negeri 1 Demak	4.58

The comparison between schools shows relatively small variation in achievement; therefore, overall, all model schools have strong readiness in deep learning implementation. However, mean differences between schools remain important as a basis for developing differentiated mentoring. Schools with higher achievement can serve as centers of best practice, while schools with relatively lower achievement need strengthening in reflection, formative assessment, applicative learning, and utilization of local context. Regarding readiness for AI-based education, the achievement of digital integration and learning resources (4.68) indicates that model schools have strong initial readiness to develop technology and AI-based learning. However, this readiness needs to be directed further, from mere technology use towards AI-supported learning that strengthens reflection, differentiation, adaptive assessment, creativity, and authentic problem-solving. According to Holmes et al. (2022), AI integration in

education should be directed to support learning personalization and strengthen student thinking capacity.

E. Emerging Thematic Pattern: Humanistic-Digital Deep Learning Ecosystem Pattern

Based on the overall findings, a conceptual pattern emerges, termed the Humanistic-Digital Deep Learning Ecosystem Pattern. This pattern indicates that DLCAAI model schools have begun to build a learning ecosystem that integrates humanistic values (safety, inclusivity, character, student-centeredness) with digital technology utilization (integration of digital resources, readiness for AI). The learning ecosystem is no longer oriented solely towards material mastery but emphasizes meaningful experiences, collaboration, student agency, and 21st-century competence development. This pattern demonstrates a shift from a conventional, administrative-oriented learning paradigm towards a more reflective, participatory, data-oriented, and applicative one.

However, the findings also show that reflection experience, formative assessment, and applicative learning remain priority areas for strengthening. This condition indicates that the transformation from surface learning to deep learning is not yet fully complete. Schools have successfully built active, safe, and inclusive classrooms but still need to strengthen students' ability to connect concepts, engage in formative assessment and applicative learning within frameworks oriented towards student dimensions. Black and Wiliam (2021) explain that effective formative assessment can improve the quality of reflective thinking and strengthen student engagement in the learning process. From the OECD (2023) perspective, future learning must develop student agency and transformative competencies. Meanwhile, UNESCO (2023) emphasizes that educational transformation in the AI era must remain rooted in human values, meaningfulness, ethics, and sustainability. Thus, the achievement of DLCAAI model schools in Central Java can be understood as an initial phase of humanistic transformation, i.e., a change from administratively oriented classrooms towards a more reflective, participatory, and meaningful learning ecosystem.

RESULT AND DISCUSSION

A. Interpretation of Findings and Theoretical Foundations

The overall achievement of deep learning implementation at 93.43% is a very strong finding, indicating that DLCAAI model schools in Central Java have reached a high level of pedagogical readiness in building meaningful, reflective, collaborative, and humanistic-digital learning. This achievement confirms that the Merdeka Curriculum and DLCAAI policy have succeeded in driving a fundamental paradigm shift in learning practices in model schools. The high achievements in joyful and psychologically safe learning (4.75) and student-centered learning and inclusivity (4.73) confirm that transformative learning cannot occur without psychological safety and pedagogical relationships that appreciate student

diversity, voices, and active participation. These findings are consistent with Noddings' (2021) care pedagogy, which states that humanistic education emphasizes empathetic relationships, well-being, and holistic development. Hattie (2023) also confirms that a positive, supportive, and safe classroom climate has a very large effect size on student learning success and achievement.

Furthermore, the high achievement in graduate profile/21st-century character (4.70) indicates that DLCAAI model schools not only focus on cognitive outcomes but also on strengthening character, collaboration, creativity, critical thinking, and communication. This aligns with the framework for 21st-century skills, emphasizing that deep learning should equip students with the competencies needed to live and work in a complex, uncertain, and rapidly changing world (Fullan et al., 2020; OECD, 2023). The achievement in digital integration and learning resources (4.68) shows that DLCAAI model schools have strong initial readiness to leverage technology and AI for learning. However, as argued by Selwyn (2022) and Holmes et al. (2022), technology integration must go beyond digitalization of materials and move towards AI-supported learning that strengthens differentiation, adaptive assessment, student creativity, and critical inquiry. Thus, the digital readiness of model schools must be directed further to build a balanced and meaningful humanistic-digital ecosystem.

B. Humanistic-Digital Learning Ecosystem

The main concept emerging from this research is the formation of an initial pattern of a humanistic-digital learning ecosystem. This ecosystem describes the integration between humanistic learning, reflective pedagogy, digital technology, AI, collaboration, and student agency. In the DLCAAI context, AI and digital technology are pedagogical instruments to strengthen exploration, reflection, differentiation, creativity, and authentic problem-solving. This approach aligns with the concept of human-centered AI in education, which positions technology as a tool for pedagogical augmentation, not a replacement for human interaction in learning (Luckin & Cukurova, 2022).

The achievement of digital integration and learning resources (4.68) shows that model schools have initial readiness to develop technology-based learning. However, this digital readiness needs to be directed further towards AI-supported learning, not merely digitizing materials or using technological devices in learning. AI needs to be positioned as a tool to strengthen adaptive assessment, learning personalization, formative feedback, learning needs analysis, and the development of students' creative work (Holmes et al., 2022). A humanistic-digital learning ecosystem requires a balance between technology and human interaction. Selwyn (2022) warns that educational technology can lead to dehumanization if used without a clear pedagogical orientation. Therefore, AI integration in DLCAAI must remain guided by humanistic pedagogical values: respecting students, building empathetic relationships, maintaining psychological safety, strengthening

character, and developing ethical awareness.

In this study, the strengths of model schools are evident in their positive learning climate, inclusivity, appreciation of students, collaboration, and character. These findings suggest that the humanistic foundation is relatively strong. The next challenge is to connect this humanistic foundation with the use of tools that genuinely enhance the learning experience, the integration of which is determined by the school's reflective pedagogical capacity and culture. Thus, the humanistic-digital learning ecosystem in this article can be understood as a learning ecosystem that integrates AI, reflective pedagogy, human interaction, student agency, and collaborative inquiry to build conscious, meaningful, joyful, adaptive, and evidence-based learning.

C. Deep Learning and Student Agency

One important finding of this study is the strong indication of strengthened student agency in DLCAAI model schools. This is evident from the high achievements in student-centered learning, inclusivity, safe atmosphere, collaboration, and character. Students are beginning to be positioned as active learners with space to participate, ask questions, collaborate, and construct understanding. This concept aligns with the theory of student agency, which positions students as the main actors in the learning process (OECD, 2023). Within the deep learning framework, student agency is a prerequisite for the emergence of active learners, reflective learners, and adaptive learners. Students as active learners engage in exploration, discussion, problem-solving, and knowledge construction. Students as reflective learners can evaluate their learning process, recognize strengths and weaknesses, and use feedback to improve understanding. Students as adaptive learners can adjust learning strategies, use technology productively, and respond creatively to changing contexts (Darling-Hammond et al., 2020).

However, data also show that indicators of student reflection, making learning improvement plans, initial assessment, and cross-disciplinary learning still need strengthening. This indicates that student agency is not sufficiently understood merely as student activeness in the classroom. Deeper agency must include students' ability to be aware of their thinking processes, monitor their learning progress, choose learning strategies, revise work, and construct meaning from learning experiences. Zimmerman (2020) refers to these abilities as the core of self-regulated learning. Thus, strengthening student agency in DLCAAI model schools needs to be directed towards three agendas: first, expanding the space for student voice and choice in learning; second, strengthening metacognitive reflection through learning journals, exit tickets, self-assessment, and development portfolios; and third, developing project-based, inquiry-based, and contextual challenge-based learning so that students can apply knowledge in real situations (Bell, 2021).

D. Policy Implications

The most important part of this research is its implications for developing evidence-based educational

policy. The baseline assessment results show that DLCAAI model schools in Central Java have a strong foundation for building humanistic, inclusive, collaborative, and digital learning. However, strengthening is still needed in student reflection, formative assessment, applicative learning, metacognition, and utilization of learning data. These findings provide concrete direction for DLCAAI policy development. First, at the DLCAAI policy level, the results affirm that DLCAAI implementation cannot be reduced to a mere technology, coding, or AI program. DLCAAI must be positioned as a pedagogical transformation policy integrating deep learning, reflective assessment, differentiation, student agency, and humanistic technology (UNESCO, 2023). Second, at the teacher training level, the results indicate the need for teacher professional development based on real needs. Teacher training should not be uniform but based on priority indicators such as metacognitive reflection, initial assessment, formative feedback, cross-disciplinary learning, and AI integration for meaningful learning based on reflective practice and authentic classroom needs. Third, at the supervision system level, principals and supervisors need to develop data-based academic supervision. Supervision should not focus solely on administrative completeness but must capture the quality of learning interactions, depth of student understanding, use of feedback, learning reflection, and the impact of learning on student character and competence. Fourth, at the AI governance level, schools need ethical and pedagogical guidelines for AI use. AI must be used to strengthen creativity, reflection, differentiation, and adaptive assessment, not to replace student thinking processes. AI policy in schools must regulate AI literacy, academic ethics, data security, work integrity, and digital responsibility (Holmes et al., 2022). Fifth, at the assessment system level, the findings affirm the need to strengthen the reflective assessment system. Initial assessment, formative assessment, feedback, self-assessment, student reflection, and learning follow-up need to be core parts of the DLCAAI cycle. Assessment must not stop at outcome measurement but must become an instrument for learning improvement (Black & Wiliam, 2021). Sixth, at the school transformation roadmap level, baseline results can be used to develop a school transformation roadmap. Schools with high achievement can become centers of best practice, while schools with relatively lower achievement receive differentiated mentoring. Thus, school transformation policy can be more precise, equitable, and data-driven.

E. Baseline Assessment as Educational Diagnosis

The results of this study affirm that baseline assessment is not merely descriptive data but an instrument of educational diagnosis. Baseline assessment provides an overview of the school's starting position, existing strengths, areas needing strengthening, and the most relevant policy intervention directions. This approach aligns with the concept of data-informed school improvement (Mandinach & Schildkamp, 2021). As a school transformation compass, baseline assessment helps schools determine the

direction of change. Data show that DLCAAI model schools are strong in humanistic learning climate, inclusivity, character, and digital integration but still need to strengthen reflection, formative assessment, knowledge application, and metacognition. Thus, schools do not make improvements randomly but based on a clear needs map. As evidence for intervention, baseline assessment provides an empirical basis for developing teacher strengthening programs, pedagogical clinics, lesson study, coaching, peer observation, and the development of DLCAAI teaching materials. Interventions are no longer assumption-based but based on indicators that clearly require strengthening. As a policy navigation system, baseline assessment helps education offices and policymakers determine transformation priorities. Data can be used to design adaptive, normative training, supervision, dissemination, monitoring, and evaluation of DLCAAI with a strong empirical basis. Therefore, baseline assessment should become a sustainable mechanism in DLCAAI implementation. Initial measurement needs to be followed by classroom observation, analysis of teaching materials, student portfolios, learning experience surveys, and evaluation of learning impact so that educational transformation can be monitored more comprehensively.

F. Research Contributions

This article provides theoretical and practical contributions to the development of educational transformation based on deep learning, artificial intelligence (AI), and data-based educational policy. Theoretically, this research enriches the concept of deep learning through empirical evidence of deep learning implementation in DLCAAI model schools in Indonesia. Deep learning is understood not only as cognitive mastery but also includes conscious, meaningful, reflective, collaborative, digital learning oriented towards strengthening the graduate profile. Furthermore, this research develops an AI-humanistic education perspective, namely the integration of AI as a pedagogical augmentation that remains controlled by humanistic values, ethics, reflection, and meaningful learning. This approach rejects the technocentric paradigm and positions technology as an instrument to support the development of learning quality and student humanity (Selwyn, 2022). This research also strengthens the concept of evidence-based educational transformation, that educational transformation requires empirical data as a basis for academic supervision, teacher training, curriculum development, and adaptive educational decision-making (Mandinach & Schildkamp, 2021). Practically, the results contribute to various educational stakeholders. School principals can utilize baseline assessment to strengthen instructional leadership, reflective supervision, and teacher learning communities. Teachers gain a map of areas for strengthening learning, such as formative assessment, student reflection, learning differentiation, and AI utilization to enhance the teacher's role in the learning process. Meanwhile, education offices and the Ministry of Primary and Secondary Education can

use the results as a basis for formulating differentiated mentoring policies, developing learning quality monitoring dashboards, data-based supervision, and ethical, humanistic, and sustainable educational AI governance.

G. Proposed Model: Baseline Architecture of Humanistic-Digital Deep Learning Ecosystem

Based on the synthesis of results and discussion, this research proposes a conceptual model called the Baseline Architecture of Humanistic-Digital Deep Learning Ecosystem. This model positions baseline assessment as the main foundation for data-based transformation of DLCAAI model schools. The model contains six main components. First, deep learning, i.e., learning that builds conceptual understanding, reflection, knowledge application, character, and authenticity. Second, AI integration, i.e., the use of AI as a pedagogical tool to support learning personalization, adaptive assessment, feedback, exploration of learning resources, and development of student creativity (Holmes et al., 2022). Third, reflective pedagogy, i.e., learning practices that provide space for students to evaluate thinking processes, assess learning outcomes, make improvement plans, and build learning awareness. Fourth, student agency, i.e., students' capacity to have voice, choice, ownership, and responsibility for their learning process (OECD, 2023). Fifth, collaborative inquiry, i.e., a collective learning culture involving teachers and students in dialogue, investigation, reflection, feedback, and co-creation of solutions. Sixth, evidence-based policy, i.e., needs mapping, assessment results, and evaluation of learning impact. This model affirms that transformation of DLCAAI model schools cannot be achieved merely through technology provision or administrative training. Sustainable transformation requires integration between data, pedagogy, technology, reflective culture, instructional leadership, and evidence-based policy. Thus, the Baseline Architecture of Humanistic-Digital Deep Learning Ecosystem can serve as both a conceptual and practical framework for strengthening the development of DLCAAI model schools.

CONCLUSION

Conclusion

This research shows that the implementation of deep learning in State Senior High Schools adopting the DLCAAI model in Central Java is in the very high category, with a mean score of 4.67 out of 5, or 93.43%. These results indicate that DLCAAI model schools have a strong, inclusive, collaborative, psychologically safe, digital technology-based foundation, and support the strengthening of 21st-century character and competence. The transformation leads to the formation of a humanistic-digital learning ecosystem that integrates technology, reflective pedagogy, humanistic relationships, and the comprehensive development of student learning capacity. DLCAAI implementation also demonstrates a paradigm shift from surface learning to deep learning that emphasizes conceptual understanding, critical reflection, student agency, contextual learning, and collaboration. The integration of Artificial Intelligence (AI)

in learning is not positioned as a replacement for teachers but as pedagogical support that helps with learning differentiation, adaptive assessment, creativity, knowledge exploration, and student learning reflection. However, this study still identifies several aspects needing strengthening, especially in learning differentiation. These findings indicate the future challenge of education is to create active, joyful learning that deepens critical thinking quality, conceptual connectedness, learning reflection, and student independence. This research simultaneously affirms the importance of educational transformation based on empirical evidence for academic supervision, teacher professional development, and strengthening the school quality culture.

Implications

Theoretically, this research contributes to the development of the concept of deep learning in the Indonesian educational context by integrating critical reflection, student agency, reflective assessment, humanistic pedagogy, and AI integration within a single learning framework. This research also strengthens the AI-humanistic education perspective, affirming that the development of educational technology must continue to be guided by humanistic values, ethics, and meaningful learning. Practically, the results can be used as a basis for strengthening school improvement in DLCAAI model schools. Principals can use the results as a basis for academic supervision, strengthening reflective coaching, and developing teacher learning communities. Teachers need to strengthen learning designs that emphasize essential questions, formative assessment, student reflection, and authentic product development. Additionally, teachers need to develop ethical, creative, and adaptive AI pedagogy to support meaningful learning. From a policy perspective, this research affirms the importance of developing evidence-based educational policy in DLCAAI implementation. The government needs to develop a deep learning supervision system that evaluates not only learning administration but also the quality of pedagogical interaction, learning reflection, formative assessment, AI utilization, and their impact on student competencies. Furthermore, strengthening ethical and humanistic educational AI governance is needed so that digital transformation maintains its pedagogical and humanistic dimensions.

Recommendations

Based on the research findings, the following recommendations are offered:

1. School principals need to strengthen the reflective learning culture through data-based academic supervision, pedagogical coaching, and the sustainable development of teacher learning communities.
2. Teachers need to improve the application of learning differentiation, formative assessment, metacognitive reflection, and cross-disciplinary learning to optimize the quality of student deep learning.
3. Schools need to develop a reflective learning culture through reflection journals, self-assessment, development

portfolios, and peer observation as part of strengthening deep learning.

4. The government needs to develop a DLCAAI data system that includes deep learning quality, AI readiness, and reflective assessment as a basis for educational policy-making.

5. The development of AI in education needs to be directed towards an ethical, humanistic, adaptive approach that supports meaningful learning, making technology a tool for pedagogical strengthening.

Further Research

This study still has limitations because it uses a teacher perception-based survey (self-report) and descriptive analysis, so the potential for subjectivity still exists. Furthermore, the scope of the research is limited to DLCAAI model schools in Central Java, so generalization of results needs to be done cautiously. Therefore, further research is recommended to use more comprehensive approaches such as SEM-PLS, mixed methods, or longitudinal studies to obtain a deeper understanding of AI-based deep learning implementation. Subsequent research can also develop a deep learning maturity index to map the relationship between deep learning quality, AI readiness, school leadership, school quality culture, and student learning outcomes. Additionally, further research can expand the geographical scope to various educational levels and different school characteristics to obtain a more contextual and nationally representative DLCAAI implementation model.

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