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AN INVESTIGATION OF TEACHERS' PERCEPTIONS TOWARD DEEP LEARNING PEDAGOGY IN PRIMARY MATHEMATICS CLASSROOMS

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Abstract

This study aims to analyze elementary school teachers' perceptions of deep learning in mathematics. This qualitative study was conducted at SDN Cipinang Melayu 09 Pagi, Jakarta (May-December 2025). Fourteen elementary school teachers were selected using purposive sampling. Data were collected through questionnaires and in-depth interviews, with method triangulation employed to ensure validity. Data analysis followed qualitative research principles through reduction, categorization, presentation, and conclusion drawing. All respondents demonstrated sound understanding of deep learning as an approach focusing on mindful, meaningful, and joyful learning and acknowledged its potential benefits in enhancing concept understanding, learning motivation, and problem-solving abilities. Teacher readiness varied, with high readiness (85.7%-100%) in basic teaching skills and collaboration, and moderate readiness (78.6%-85.7%) in practical implementation. Major barriers included infrastructure limitations (71.4%), administrative burden (57.1%-64.3%), and insufficient training (78.6% had attended related training). All respondents (100%) expressed strong expectations for specialized training, adequate devices, government support, and user-friendly platforms. While teachers possessed positive perceptions and sound conceptual understanding of deep learning, effective implementation requires comprehensive systemic support including intensive training, adequate infrastructure, user-friendly platforms, policy support, reduced administrative burden, continuous mentoring, and communities of practice. With such support, deep learning possesses significant potential to transform elementary mathematics instruction.

Keywords: Deep learning, Mathematics, Primary School, Teachers' Perceptions

Abstrak

Penelitian ini bertujuan untuk menganalisis persepsi guru sekolah dasar tentang pembelajaran mendalam dalam matematika. Studi kualitatif ini dilakukan di SDN Cipinang Melayu 09 Pagi, Jakarta (Mei-Desember 2025). Empat belas guru sekolah dasar dipilih menggunakan metode purposive sampling. Data dikumpulkan melalui kuesioner dan wawancara mendalam, dengan metode triangulasi digunakan untuk memastikan validitas. Analisis data mengikuti prinsip-prinsip penelitian kualitatif melalui reduksi, kategorisasi, presentasi, dan penarikan kesimpulan. Semua responden menunjukkan pemahaman yang baik tentang pembelajaran mendalam sebagai pendekatan yang berfokus pada pembelajaran yang penuh perhatian, bermakna, dan menyenangkan, serta mengakui potensi manfaatnya dalam meningkatkan pemahaman konsep, motivasi belajar, dan kemampuan pemecahan masalah. Kesiapan guru bervariasi, dengan kesiapan tinggi (85,7%-100%) dalam keterampilan mengajar dasar dan kolaborasi, dan kesiapan sedang (78,6%-85,7%) dalam implementasi praktis. Hambatan utama meliputi keterbatasan infrastruktur (71,4%), beban administrasi (57,1%-64,3%), dan pelatihan yang tidak memadai (78,6% telah mengikuti pelatihan terkait). Seluruh responden (100%) menyatakan harapan yang tinggi terhadap pelatihan khusus, perangkat yang memadai, dukungan pemerintah, dan platform yang mudah digunakan. Meskipun para guru memiliki persepsi positif dan pemahaman konseptual yang baik tentang pembelajaran mendalam, implementasi yang efektif membutuhkan dukungan sistemik yang komprehensif termasuk pelatihan intensif, infrastruktur yang memadai, platform yang mudah digunakan, dukungan kebijakan, pengurangan beban administratif, pendampingan berkelanjutan, dan komunitas praktik. Dengan dukungan tersebut, pembelajaran mendalam memiliki potensi signifikan untuk mentransformasi pengajaran matematika di sekolah dasar.

Kata kunci: *Pembelajaran Mendalam, Matematika, Sekolah Dasar, Persepsi Guru*

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INTRODUCTION

Global education is entering an era that demands fundamental shifts in learning processes. Indonesia's Vision 2045 and the reality of demographic bonus necessitate an education system capable of producing graduates who not only master content knowledge but also possess future competencies, including critical thinking, complex problem solving, creativity, collaboration, and effective communication (OECD, 2023b). These competencies form the core of Higher Order Thinking Skills (HOTS), essential for navigating the 21st century.

However, international assessment data reveal serious challenges for Indonesia. The 2022 Programmed for International Student Assessment (PISA) results released by (OECD, 2023a) highlight that most Indonesian students (approximately 74-81%) can only answer questions at levels 1-3 (Lower Order Thinking Skills) in reading, mathematics, and science, with less than 1% reaching levels 4-6 (HOTS). This alarming gap between future vision and current student performance has become a national urgency. Mathematics, as a fundamental pillar of numeracy, is often taught procedurally with an emphasis on memorizing formulas rather than developing deep conceptual understanding (R. Hidayat et al., 2022). This situation is further compounded by teachers' perceptions of deeper learning, which tend to be narrow and not yet embedded in instructional practices and represent a critical factor influencing low HOTS achievement in mathematics. When teachers perceive deeper learning as overly complex or non-essential, they are more likely to avoid instructional strategies that foster exploration and higher-order reasoning, thereby perpetuating the very gap that national educational reforms seek to close.

In response to this educational quality crisis, the Ministry of Education, Culture, Research, and Technology introduced the concept of "Deeper Learning", designed to help students develop robust understanding and the ability to transfer knowledge to new situations. This framework focuses on six core competencies: (1) mastery of core academic content, (2) critical thinking and problem solving, (3) collaboration, (4) effective communication, (5) self-directed learning, and (6) development of academic mindset (Kemendikdasmen, 2025).

The success of this ambitious curriculum reform depends critically on teachers, who serve as gatekeepers of innovation and translate policy vision into classroom reality (Hargreaves & Fullan, 2012; M. T. Hidayat et al., 2025). Teacher perceptions how they view, interpret, and evaluate new concepts directly influence their attitudes and classroom actions

(Wubbena & Guerra, 2017). Historical evidence from global educational reforms demonstrates that teacher beliefs about how students learn serve as the strongest predictor of teaching practices, often stronger than the training they receive (Tondeurab et al., 2017). If teachers perceive deeper learning merely as "new administrative burden" or "idealistic but impractical," implementation will be superficial. Conversely, reforms that conflict with teachers' core beliefs tend to be rejected or adapted superficially to fit existing practices (Hargreaves & Fullan, 2012). Therefore, before advancing to training or evaluation, the most urgent initial step is conducting a diagnosis: "What exactly is in elementary school teachers' minds when they hear the term 'Deeper Learning' in the context of mathematics teaching?"

This research addresses this gap by specifically examining elementary school teachers' perceptions of Deeper Learning in mathematics instruction. Although the concept of "Deeper Learning" is gaining attention in Indonesian educational discourse, existing studies remain nascent and largely confined to policy-level analysis, leaving grassroots teacher perspectives, particularly at the elementary level largely unexplored. Prior research has tended to focus on fragmented constructs such as HOTS or project-based learning in isolation; however, Deeper Learning offers a more holistic and integrated framework encompassing six interconnected competencies, which has not yet been systematically investigated from the perspective of teachers as curriculum enactors. By bridging three critical and underexplored areas, the introduction of Deeper Learning within the Indonesian policy context, the pivotal role of teacher perceptions as mediators of instructional reform, and the foundational domain of elementary mathematics. This study positions itself at the intersection of policy intention and classroom reality, offering empirical insights essential for meaningful pedagogical transformation.

METHODS

This qualitative descriptive study was conducted at SDN Cipinang Melayu 09 Pagi from May to December 2025, focusing on elementary school teachers' perceptions of deeper learning in mathematics instruction. Qualitative research was chosen to explore meanings constructed by participants within specific social contexts (Creswell & Creswell, 2018). Emphasizing the collection of information from multiple sources to provide a comprehensive understanding.

Participants were selected using a purposive sampling technique involving 15 teachers from SDN Cipinang Melayu 09 Pagi, an urban public elementary school with A accreditation

and adequate but modest facilities. The school serves students from diverse socioeconomic backgrounds, predominantly from middle to lower-income families, and is characterized by a collaborative yet traditionally oriented school culture where teacher autonomy is valued but instructional innovation remains nascent. Participant selection was based on the teachers' direct classroom teaching experience and their ability to provide critical perspectives on deeper learning in mathematics education. This sampling method ensured that participants possessed relevant expertise and insights grounded in the specific contextual realities of the school.

Data were collected through two primary instruments: questionnaires and in-depth interviews. Questionnaires captured teachers' perceptions of deeper learning and its potential application in mathematics instruction, while in-depth interviews explored teachers' perspectives, experiences, and challenges in greater depth. The use of multiple data collection techniques is essential for obtaining richer and more valid data (Patton, 2015).

To ensure the trustworthiness of the data, this study employed credibility strategies through method triangulation, comparing questionnaire results with interview findings to identify converging and diverging themes (Denzin & Lincoln, 2017). Specifically, quantitative questionnaire data were analyzed to identify patterns in teachers' perceptions, while interview data provided deeper explanations that were systematically cross checked against the questionnaire results. To further enhance credibility, member checking was conducted by inviting participants to review their interview transcripts and preliminary interpretations to confirm accuracy and resonance with their intended meanings.

Data analysis followed qualitative research principles through processes of reduction, categorization, presentation, and conclusion drawing. This non-statistical approach organized data into patterns and categories to derive meanings relevant to research objectives (Moleong, 2019), directing analysis toward understanding how teachers interpret deeper learning and opportunities for its implementation in improving mathematics instruction quality in elementary schools.

RESULT AND DISCUSSION

This study involved 14 elementary school teachers from SDN Cipinang Melayu 09 Pagi, Jakarta, consisting of 9 female teachers (64.3%) and 5 male teachers (35.7%), with ages ranging from 26 to 50 years, predominantly in the productive age category of 36-47 years.

Teachers' Understanding of Deeper Learning Concept

Questionnaire data analysis revealed that nearly all respondents (100%) agreed or

strongly agreed that they understood deeper learning as a learning approach focusing on mindful, meaningful, and joyful learning. This indicates that the fundamental concept of deeper learning was well understood by teachers at the school. Regarding deeper learning elements: all respondents (100%) understood that deeper learning could be applied in elementary mathematics instruction, could adapt learning to students' individual abilities, could help address students' mathematics learning difficulties, and could provide more engaging learning experiences for elementary students.

However, a knowledge gap existed regarding technical aspects and training. Data showed that 85.7% of respondents agreed or strongly agreed they knew deeper learning as part of AI, though one respondent (7.1%) strongly disagreed. Only 78.6% had attended training, seminars, or webinars related to AI-integrated deeper learning, with two respondents (14.3%) disagreeing and one uncertainty. Additionally, uncertainty existed in understanding the difference between deeper learning and conventional mathematics learning applications such as Photo math and GeoGebra, with one respondent expressing doubt.

Perceived Benefits of Deeper Learning in Mathematics Instruction

All respondents (100%) expressed positive attitudes (agree/strongly agree) toward various benefits of deeper learning, including its ability to help teachers identify students experiencing mathematics learning difficulties, facilitate explanation of abstract mathematical concepts to elementary students, enhance mathematics instruction effectiveness in classrooms, improve students' mathematical problem solving abilities, facilitate teachers' evaluation of mathematics learning outcomes, and provide supplementary material recommendations tailored to students' weaknesses.

Teachers' Readiness to Implement Deeper Learning

Analysis revealed varied levels of teacher readiness. High readiness (85.7%-100%) was demonstrated in possessing basic teaching skills to support deeper learning implementation, ability to adapt lesson plans to align with deeper learning implementation, willingness to collaborate with other teachers, and recognition of needing specialized training for deeper understanding of implementation. Moderate readiness (78.6%-85.7%) was shown in feeling prepared to implement deeper learning in mathematics instruction, possessing skills in using technology-based mathematics learning applications, and confidence in attempting to integrate deeper learning with AI.

Implementation Barriers and Challenges

Based on questionnaire data, major barriers identified included infrastructure and

facility limitations, with 71.4% of respondents stating that school facilities and infrastructure were inadequate, 71.4% mentioning limited availability of devices (laptops, tablets, projectors), and one respondent strongly agreed with these limitations. Administrative burden and time constraints were evident, as 64.3% felt deeper learning implementation required additional time in preparing instruction, and 57.1% stated administrative burdens made it difficult to develop deeper learning-oriented instruction.

Lack of knowledge and training emerged as significant barriers, with 64.3% of teachers acknowledging insufficient AI knowledge as an obstacle, 71.4% stating absence of official government guidelines made them hesitant to implement, and 64.3% mentioning required costs remained quite high. Specific constraints mentioned by respondents included required learning devices, limited resources and teacher skills, dense curriculum, assessment and evaluation challenges, student concentration on learning, limited time, learning media and student characteristics, inability to teach every material through games or ice breaking, inability to apply deeper learning in every session, infrastructure and human resource limitation, and data requirements.

Teachers' Hopes and Expectations

All respondents (100%) strongly agreed or agreed with various expectations, including hoping for specialized training for elementary teachers on deeper learning, expecting schools to provide supporting devices (computers, applications), hoping for government support in mentoring elementary schools, desiring simple and user-friendly applications or platforms, hoping deeper learning becomes a sustainable innovation in mathematics instruction, and expecting it to help students understand mathematical concepts, assist assessment processes, and enhance learning enthusiasm.

Discussion

Understanding of Deeper Learning Concept in Educational Context

Results demonstrated that teachers at SDN Cipinang Melayu 09 Pagi possessed sound understanding of the fundamental concept of deeper learning as a learning approach emphasizing mindfulness, meaningful, and joyful learning. This finding aligns with concepts articulated by Minister of Primary and Secondary Education Abdul Mu'ti, indicating that deeper learning in educational contexts refers not merely to AI technology but to profound learning approaches promoting holistic, reflective, and meaningful concept understanding.

According to (Diputera et al., 2024), meaningful learning occurs when students can

connect new information with what they already know, leading to deep understanding of concepts. In mathematics instruction, this is particularly relevant as mathematical concepts are interconnected and built upon one another. Teachers' understanding of this meaningful aspect was reflected in their statements that deeper learning can be adapted to students' individual abilities and helps address learning difficulties.

The mindful learning aspect, known in educational theory as metacognition, encourages students to remain aware of their ongoing learning processes (Wang, Q.; Zhang, Y.; Zhang, Y.; Chen, 2023). Teachers in this study understood that deeper learning can help identify students experiencing difficulties, which constitutes part of mindful learning awareness. Meanwhile, the joyful learning aspect emphasizing the importance of creating positive learning atmospheres was understood by all respondents to make students enjoy the mathematics learning process.

Potential of Deeper Learning in Enhancing Mathematics Instruction

Teachers' positive perceptions of deeper learning benefits in elementary mathematics instruction were extremely high (100% agree/strongly agree). This finding supports (Barokah & Mahmudah, 2025), stating that elementary mathematics learning transformation through deeper learning proves effective in enhancing student motivation and achievement. Strategies such as problem-based learning (PBL), project-based learning (PJBL), and utilization of interactive learning technology consistently improve student engagement.

(Mutmainnah et al., 2025) found that deeper learning implementation in elementary mathematics instruction can enhance students' conceptual understanding. This approach enables learning focused not only on procedural mastery but also on deep conceptual understanding and ability to apply concepts in different contexts. The potential for learning personalization mentioned by respondents, aligns stating that deeper learning enables adaptive learning personalization. This is crucial in mathematics instruction as each student possesses different levels of understanding and learning speeds. Adaptive learning systems can adjust problem difficulty levels and learning materials according to each student's abilities.

Teacher Readiness: Between Competence and Challenges

Despite high levels of deeper learning concept understanding, teacher readiness for implementation showed interesting variation, reflecting gaps between theoretical understanding and practical readiness. (Rochim et al., 2025) in their research on Indonesian language teachers' perceptions found similar patterns, where although teachers possessed sound conceptual understanding, they still required specialized training for effective implementation.

(M. T. Hidayat et al., 2025) emphasized the importance of building deeper learning mindsets among elementary school teachers through concept-based curriculum development, intensive teacher training, and implementation of interactive learning strategies. This finding is relevant to current research results showing that 100% of respondents stated they needed specialized training.

(Kim & Kwon, 2023) in their research on AI competencies of elementary school teachers in South Korea found that not all educators possessed sufficient understanding of AI technology and deeper learning. Without adequate training, teachers might struggle to integrate this technology into curriculum and optimize its use. This aligns with current research findings that only 78.6% of respondents had attended training related to.

Infrastructure and Systemic Barriers

Research findings showed that infrastructure barriers constituted major obstacles (71.4% of respondents). This aligns with the (Badan Pusat Statistik, 2023) stating that more than 30% of elementary schools in Indonesia lack adequate technological access to support digital-based learning. (Graves et al., 2021) confirmed that limited technology infrastructure constitutes one of the main obstacles to deeper learning implementation. Many schools in remote areas lack adequate internet access, and not all teachers and students possess devices supporting modern learning technology.

Administrative burden mentioned by 57.1% of respondents also emerged as an important issue. (Yustitia et al., 2025) in their research on optimizing innovative learning based on deeper learning found that high teacher administrative burdens reduce teaching effectiveness and time for developing learning innovations.

Pedagogical and Contextual Challenges

Several respondents mentioned specific pedagogical challenges, such as "not every material can be taught through games" and "deeper learning cannot be applied in every session." This finding indicates that teachers possess reflective awareness about deeper learning approach limitations.

(D. Parinduri, M. Lani, M. S. Silalahi, M. Afrika, E. Mailani, 2024) in their analysis of student difficulties and teacher roles in mathematics learning emphasized that learning approaches chosen by teachers play important roles in determining student success. Not all mathematics materials suit the same approach, and teachers need flexibility in selecting appropriate strategies.

Student concentration mentioned as an obstacle also aligns with findings by (Kovač et

al., 2025), stating that efforts to enhance science literacy abilities through deeper learning approaches require special attention to elementary students' characteristics and cognitive development levels.

Relevance to Merdeka Curriculum and 21st Century Competencies

Teacher readiness to adapt lesson plans (100% agree/strongly agree) demonstrated that teachers understood the importance of integrating deeper learning with existing curriculum. (Darozad et al., 2025) stated that meaningful learning transformation through deeper learning within the Merdeka Curriculum framework can enhance student engagement and higher order thinking skills development.

(Astuti, 2024) identified six key competencies called "6C": Character, Citizenship, Collaboration, Communication, Creativity, and Critical Thinking. Her research showed that schools implementing deeper learning approaches experienced significant increases in student learning motivation and higher order thinking skills development.

Implications for Policy and Practice

Teacher expectations for specialized training, device provision, and government support (100% agree/strongly agree) indicated the need for comprehensive systemic support. Implementation of success requires systemic support in the form of teacher training, integrated policies, and comprehensive evaluation instruments.

(Suwandi et al., 2024) emphasized that educational innovation with deeper learning models requires cooperation and synergy among various educational elements, including teachers, students, parents, and school environments. Several implementable steps include socializing deeper learning concepts to all related parties and conducting regular monitoring and evaluation.

Teacher hopes for simple and user-friendly platforms align with user-friendly learning design principles. (Yustitia et al., 2025) in their research on optimizing innovative learning based on deeper learning suggested that learning platforms should be designed according to student and teacher needs, even remaining operable without internet connectivity.

Synthesis and Recommendations

Based on data analysis and literature review, several important findings emerged. First, a gap exists between understanding and implementation: despite high conceptual understanding, practical implementation still faces various barriers, indicating the need for bridges between theory and practice through hands-on training and continuous mentoring. Second, systemic support is essential: deeper learning implementation cannot stand alone but

requires support from various aspects including infrastructure, policy, training, and school culture. Third, gradual and contextual approaches are necessary: teacher awareness that not all materials suit deeper learning approaches demonstrates the need for flexible and contextual implementation approaches rather than one-size-fits-all solutions. Fourth, collaboration serves as key: high teacher readiness to collaborate (100%) shows potential for professional learning through communities of practice and lesson study.

CONCLUSION

This study demonstrated that elementary school teachers possessed positive perceptions and sound understanding of the deeper learning concept in mathematics instruction. They acknowledged deeper learning's significant potential in enhancing concept understanding, learning motivation, and students' problem-solving abilities. However, effective implementation still faced substantial barriers related to infrastructure, administrative burden, lack of specific training, and resource limitations.

Successful implementation of deeper learning in elementary mathematics instruction requires a holistic approach involving: (1) intensive and continuous teacher training, (2) adequate infrastructure and supporting devices, (3) user-friendly learning platforms, (4) policy support and clear official guidelines, (5) reducing teachers' administrative burdens, (6) sustained mentoring and monitoring, and (7) the development of communities of practice among teachers. Within the setting examined, integrated systemic support appears to enable deeper learning to function as a sustainable innovation, with the potential to transform mathematics instruction toward more meaningful, mindful, and joyful learning experiences for students. However, these findings should be interpreted with consideration of the study's limitations, including its focus on a limited number of schools with specific characteristics, a relatively small participant size, and methodological emphasis on depth of analysis over generalizability. Consequently, the implications drawn are contextual in nature and warrant further investigation across more diverse settings to develop a more comprehensive understanding.

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