Kontinu: Jurnal Penelitian Didaktik Matematika
E-ISSN: 2656-5544
P-ISSN: 2715-7326
Vol. 9, No. 2: November 2025
Hal. 254-266

Understanding Mathematics Teachers' Perspectives on Deep Learning Oriented to Students' Computational Abilities

Khoerul Umam[1)*], Ishaq Nuriadin[2)], Ervin Azhar[3)], Hari Setiadi[4)]

Program Studi Pendidikan Matematika, Universitas Muhammadiyah Prof. DR. HAMKA, Jakarta, Indonesia

*Corresponding e-mail: khoerul.umam@uhamka.ac.id

Abstract. Good and quality mathematics learning is influenced by mathematics teachers' beliefs about appropriate learning strategies and methods. This study aims to determine the extent to which mathematics teachers prepare, develop, and adapt deep learning in mathematics classrooms. Mathematics teachers were the subjects of this study because the foundation of the strength of mathematics learning in its implementation is highly dependent on their perceptions. Data collection was conducted face-to-face and online, combining in-depth interviews and closed-group discussions. The data were analyzed using thematic analysis, combining themes and categories formed during the analysis process. The results indicate the relevance of deep learning in the context of mathematics learning, the diverse readiness of mathematics teachers in implementing deep learning, and the need for training required by teachers to support the creation of higher-quality learning. The impact of this research will provide input to the government in implementing the program, the need for regular evaluation and structured and massive training so that implementation can be carried out more evenly throughout Indonesia.

Keywords: Teacher Perspective, Mathematics, Deep learning, Computational Ability, Learning.

INTRODUCTION

Rapid technological developments require robust educational preparation, given the broad challenges and opportunities (Eryanti et al., 2022; Tamami et al., 2021). The integration of deep learning is essential for instilling a variety of relevant computational skills. These skills extend beyond the use of tools to encompass how students solve complex problems, plan computationally-based problem-solving steps, and analyze and evaluate the results. This shift will encourage and stimulate traditional mathematics learning to become more comprehensive and relevant (Ikram et al., 2021; Kharisma et al., 2023).

Traditional mathematics learning emphasizes logical reasoning and problem-solving (Husain et al., 2023). However, rapid technological developments have enabled students to utilize more than just tools to solve problems, but also to incorporate complex computations to complete the solution stages (Kurniasih et al., 2021; Miao et al., 2020). Previous research reinforces the principle that deep learning transforms abstract mathematics learning into a more realistic, data-driven, and technology-driven learning experience (García González & Sierra, 2020).

Deep learning stimulates students to identify complex patterns in data and make predictions, offering an innovative approach to deepening mathematical understanding (Andono et al., 2022). For example, students using deep learning models are able to optimize multivariate concepts, producing highly representative visual results (García & Bosch, 2006; Pepin et al., 2025). This type of mathematics learning fosters and encourages students to solve more mathematical problems, thus fostering the seeds of self-confidence essential to the mathematics learning process.

While deep learning offers significant potential, its success depends heavily on the perspective and readiness of mathematics teachers to implement it in the classroom (Kenan, 2017; Nakawa & Kosaka, 2025). Teachers play a leading role in implementing curriculum and pedagogical innovations oriented toward deep learning-based mathematics learning. Therefore, a comprehensive understanding of deep learning and increased teacher awareness of its use in developing students' computational skills, as well as the challenges that may be encountered in its implementation, are crucial factors.

Teachers' perspectives on mathematics learning methods and strategies significantly influence their ability to teach mathematics. A key question that needs to be addressed is: how do teachers view deep learning as an empowering tool or as an additional complexity? How do teachers balance the learning of traditional mathematical concepts with the introduction of updated computational paradigms? These questions will encourage teachers to express their thinking. This is crucial, given that teachers' mathematics learning is always influenced by their perspectives on the methods and strategies they choose.

Therefore, this study will focus on understanding mathematics teachers' perspectives on deep learning mathematics learning, focusing on students' computational abilities as a key element that requires attention. By exploring teachers' views, beliefs, experiences, and needs, we can identify factors that support or hinder innovation in mathematics learning.

RESEARCH METHOD

This study uses qualitative methods to provide a comprehensive overview of teachers' perspectives. The data will focus on descriptive data, interview transcriptions, and field notes, making qualitative research an appropriate method for achieving the research objectives.

The subjects of this study were mathematics teachers teaching in junior high and high schools in the Jakarta and Bekasi areas. Subject selection was based on snowball sampling in each city, so that from each selected school, two mathematics teachers were selected who possessed good communication skills and understood the mathematics learning issues faced. The considerations of the principal and colleagues were among the factors used by the researcher in selecting the research subjects, minimizing the possibility of errors in data collection in the field.

Data collection was conducted in stages, both offline and online, to minimize time constraints. Teacher availability was a primary consideration because this research was conducted during school hours. Data collection also took into account permission from the mathematics teacher's superior and the mathematics teacher coordinator. Some teachers were accompanied by the coordinator, resulting in several forms, including in-depth interviews and small-scale focus group discussions.

This research data analysis was conducted by comparing transcription data between subjects, thus using source triangulation. This study focused on data collected from multiple perspectives, ensuring a more comprehensive analysis. Field notes during observations strengthened the literature and evidence of the impact of deep learning on mathematics instruction. The collected data were then grouped based on themes and categories, enabling smoother and more effective data analysis.

Kontinu: Jurnal Penelitian Didaktik Matematika
E-ISSN: 2656-5544
P-ISSN: 2715-7326
Vol. 9, No. 2: November 2025
Hal. 254-266

RESULTS AND DISSCUSSION

Analysis Of Teachers' Perceptions Of The Relevance Of Deep Learning In The Mathematics Curriculum

Research studies suggest that the majority of mathematics teachers have a positive perspective on the potential of deep learning to enrich a more comprehensive understanding of mathematical concepts, making them more relevant and adaptive amidst rapid change (Köğce, 2022). This finding aligns with several previous studies highlighting the importance of computational skills in modern mathematics education (Espinoza-Vásquez et al., 2024). One teacher stated, "Deep learning really helps students see mathematics more closely" (G05). Another teacher also emphasized, "How computers can learn from data is quite an interesting concept. Students need to develop a computational mindset from an early age" (G09). Furthermore, there is a belief that this integration will stimulate increased student motivation, as stated, "By learning mathematics like this, children become more enthusiastic" (G01).

This finding aligns with several studies in several countries, both of which found that teachers there also have optimistic views about the role of AI and deep learning in directing more relevant mathematics learning (Klang et al., 2021). This comparative study demonstrates a global trend where teachers are recognizing a shift in student competency needs from analytical skills to computational thinking (Winje & Løndal, 2023). Research highlighting the integration of deep learning into mathematics learning significantly improves students' ability to solve non-routine problems, a finding consistent with teacher G09's belief in the importance of a computational mindset (Melesse & Belay, 2022).

This positive teacher support indicates that positive perceptions of mathematics learning innovations have already developed rapidly in Indonesia. This finding contrasts with studies that have shown teacher skepticism toward the use of complex technology in mathematics classrooms, possibly due to a lack of infrastructure and training at the time. This research provides strong empirical evidence that positive teacher perceptions are a key contributing factor to the successful implementation of AI-based technology. Consequently, future teacher training programs and curriculum development should leverage these positive beliefs as a starting point, rather than expending resources on overcoming resistance that may no longer be relevant. Thus, this research provides valuable insights for designing effective and efficient implementation strategies, thereby accelerating the adoption of deep learning technology in mathematics learning in Indonesia.

Analysis Of Teachers' Pedagogical Readiness Level In Implementing Deep Learning

Mathematics teachers have diverse backgrounds and experiences and the opportunity to participate in various training programs, significantly influencing their readiness to integrate deep learning into mathematics instruction. This finding is consistent with studies on the adoption of new technologies among educators (Kamberi, 2025; Klang et al., 2021). Many teachers expressed enthusiasm but also acknowledged limitations in their technical and pedagogical knowledge. "Honestly, I don't really understand what deep learning is, and I still don't have a clear idea of how to teach it in math class. Do I have to learn coding from scratch?" (G03) reflects a common concern. However, some were already prepared, "I feel quite confident about the basic concepts of deep learning and coding because I've learned a bit before. The challenge is how to design it into a more effective math learning activity" (G07). Another teacher who had tried it admitted, "I think the key is simplifying the concepts so students aren't overwhelmed. The pedagogy might be more project-based learning" (G12). These findings regarding varying levels of teacher readiness align with several studies that explain that teacher readiness to integrate computing is closely related to relevant training (Boekaerts et al., 1995). Other studies have shown that prior experience and education play a crucial role in technology adoption. However, there are also significant differences, with studies showing more equitable teacher readiness, likely influenced by structured teacher professional development programs and systematic government support (Bikner-Ahsbahs, 2025; Brandsæter & Berge, 2025). This concern, expressed by teacher (G03), regarding a lack of technical and pedagogical knowledge, aligns with research identifying teacher technological literacy as a major barrier. However, other teachers' perspectives suggest that solutions can be found through appropriate pedagogical approaches, such as simplifying concepts and project-based mathematics learning.

This highlights the recognition that teacher preparation is a crucial element that requires attention from all parties. Teachers, as the primary actors in creating and promoting successful mathematics learning in the classroom, need to be designed to continuously improve their pedagogical and technical skills. Regular training will prepare teachers for a variety of complex mathematics learning situations. Designed preparation will reduce teacher stress levels while providing ample opportunities for teachers to implement their professionalism. With more structured preparation and training, teachers will be able to face various challenges, both in and outside the classroom, when serving students in mathematics learning. Improving the quality of teacher service to students is a crucial element in the educational transformation that prioritizes quality and speedy service, especially for private schools in Indonesia.

Analysis Of Challenges And Obstacles In Implementing Deep Learning In Mathematics Classes

Teachers identified several significant barriers that could hinder the adoption of deep learning in mathematics instruction, reflecting the challenges of implementing innovation in educational settings, as frequently reported in the literature (Nelvia, 2019; Shi et al., 2023). These barriers included infrastructure issues, lack of material support, and time constraints. "Our main challenge here is that there aren't many computers at school, and the internet connection is often intermittent" (G02). This illustrates the pressing infrastructure issue. Furthermore, "Teaching time is already very limited. If we have to add deep learning material, where will the time be allocated? Not to mention, I have to prepare all the material from scratch" (G08). Another challenge related to curriculum and assessment also emerged: "Besides infrastructure, the curriculum itself doesn't accommodate this. How will it be assessed? Should there be a special exam related to deep learning?" (G06)."

The barriers identified by these teachers align with findings highlighting that limited technological infrastructure is a universal barrier to the adoption of educational technology in developing countries (Alrajhi, 2024; Atmini et al., 2024). Comparative studies with developed countries indicate that infrastructure issues tend to be relatively minor, but challenges related to curriculum integration and teaching materials development remain relevant (Binothman et al., 2024; Stapleton, 2011). Teachers' statements (G08 and G06) regarding time, curriculum, and assessment constraints align with research highlighting the need for structural changes in the curriculum to accommodate innovation (Schindler et al., 2025).

The contribution of deep learning to mathematics learning faces several complex challenges in its implementation in the classroom. The dependence on high-tech learning and internet access presents a significant challenge. Limited access to laptops for individual students can be a barrier, as not all students have laptops for classroom learning. Limited implementation is one of the things that can be done at this time, while overall implementation in the class needs to consider the readiness of the necessary technology.

Teacher Training Needs Analysis For Professional Development In Deep Learning

The need for structured, comprehensive, and practical teacher training programs is a key element in transforming mathematics learning toward a more adaptive approach (Gurmu et al., 2024). The desired training encompasses not only technical aspects but also effective pedagogical strategies. One interview excerpt states, "I really need training that is not just theoretical, but also hands-on, for example, on how to use a simple deep learning library in Python" (G04). Teachers also expect the training to provide specific guidance. "The training we're looking for should provide concrete examples for classroom implementation. It shouldn't be too sophisticated, but it shouldn't be too basic either" (G11). Furthermore, they seek support for assessment: "The training should also be able to measure students' computational abilities after learning with deep learning. This could be done through projects, portfolios, or other methods" (G10).

These findings align with research emphasizing the importance of practice-oriented training and real-world cases to enhance technology adaptation (Çalık, 2013; Istikomah & Wahyuni, 2018). Comparative studies also show that effective teacher training must be integrated with curriculum requirements and provide implementation examples that can be adapted to classroom contexts (Maarif et al., 2022; Tamami et al., 2023; Umam et al., 2019). However, these findings contrast with teacher training approaches in several developed countries, which focus more on theoretical frameworks and developing independence, assuming teachers already possess basic technological literacy. This indicates that the Indonesian context requires a more hands-on and structured approach.

The results of this study, which emphasize teacher training, have been well-received by the Indonesian government, providing various structured training courses at both the lowest and highest levels, provided by national instructors. These trainings address not only theoretical aspects but also practical aspects of implementing deep learning in the classroom. Despite this, all stakeholders play a crucial role in maintaining, developing, and sustaining the benefits of the existing mathematics curriculum. However, intensive training on deep learning is a crucial element, as training a single teacher does not guarantee immediate learning changes. This impacts school policies, parental willingness, and the level of active student participation in mathematics learning. Students need to realize that mathematics is essential for facing various challenges, including the future of work that requires computational thinking skills.

CONCLUSION

The findings of this study conclude that mathematics instruction integrated with deep learning faces multidimensional challenges. Teachers' positive views on the potential of this innovation simultaneously enhance students' computational competencies. Teachers are also enthusiastic about preparing a variety of learning support tools and studying a wide variety of tennis skills. Teachers' positive attitudes toward deep learning integration are challenged by structural and systemic obstacles, including infrastructure, overly rigid curricula, and a lack of understanding of comprehensive training programs. Therefore, the success of deep learning implementation depends heavily on strategic steps that focus not only on improving teacher literacy and numeracy but also on developing a supportive and numeracy education ecosystem through the provision of adequate infrastructure, the development of a more adaptive curriculum, and the design of integrated training programs.

Future research should evaluate how non-pedagogical barriers should be addressed to support the integration of deep learning into mathematics learning. Quality mathematics learning is supported by a sound understanding of the mathematics learning process, the development of mathematics learning support, and a supportive environmental system. Future research should also consider the extent of parental involvement in the mathematics learning process, as active, quality mathematics learning supported by a family environment will positively impact students' psychological well-being. Parental attention and support for mathematics learning are crucial, given that many student activities occur at home. Therefore, parental attention to the mathematics learning process at home will support the creation of learning objectives that are easier for students to achieve by the end of the semester. With the support of a mutually reinforcing school and family environment, it will have a very significant impact on students' mathematics learning achievement, making expectations and learning objectives easier to achieve. This created will have a very significant impact on the progress of higher-quality mathematics learning because families understand the importance of learning mathematics not only limited to school, but also the benefits that students will feel in their future lives.

REFERENCES

Alrajhi, A. S. (2024). Artificial intelligence pedagogical chatbots as L2 conversational agents. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2327789

Andono, J., Nugroho, B. P., & Handayani, R. (2022). Analisis Kesulitan Belajar Siswa Dalam Mata Pelajaran Matematika Pada Materi Program Linear Kelas X SMK Muhammadiyah 1 Kotabumi. International Journal of Progressive Mathematics Education, 2(2), 74–83. https://doi.org/10.22236/ijopme.v2i2.8900

Atmini, S., Jusoh, R., Prastiwi, A., Wahyudi, S. T., Hardanti, K. N., & Widiarti, N. N. (2024). Plagiarism among accounting and business postgraduate students: a fraud diamond framework moderated by understanding of artificial intelligence. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2375077

Bikner-Ahsbahs, A. (2025). How eye tracking may advance the field of mathematics education: a commentary on the ESM Special Issue on eye-tracking research in mathematics education. Educational Studies in Mathematics, 555–574. https://doi.org/10.1007/s10649-025-10386-0

Binothman, M., Alhabbash, M., Al Mohammedi, N., & Ibrahim, A. (2024). Unraveling high-school students' learning experiences in English, Science, and Math: a mixed methods study. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2351243

Boekaerts, M., Seegers, G., & Vermeer, H. (1995). Solving math problems: Where and why does the solution process go astray? Educational Studies in Mathematics, 28(3), 241–262. https://doi.org/10.1007/BF01274175

Brandsæter, A., & Berge, R. L. (2025). Promoting mathematical competence development through programming activities. Educational Studies in Mathematics, 225–247. https://doi.org/10.1007/s10649-024-10380-y

Çalık, M. (2013). Investigation of junior secondary students' perceptions of mathematics classroom learning environments in china. Eurasia Journal of Mathematics, Science and Technology Education, 9(3), 273–284. https://doi.org/10.12973/eurasia.2013.935a

Eryanti, I., Sallah, E. K., & Gakuba, E. (2022). Profiling students' algebraic thinking ability in solving problems System Of Linear Equations Two Variables in vocational educational schools. International Journal of Progressive Mathematics Education, 2(1). https://doi.org/10.22236/ijopme.v2i1.8878

Espinoza-Vásquez, G., Henríquez-Rivas, C., Climent, N., Ponce, R., & Verdugo-Hernández, P. (2024). Teaching Thales's theorem: relations between suitable mathematical working spaces and specialised knowledge. Educational Studies in Mathematics, 271–293. https://doi.org/10.1007/s10649-024-10367-9

García, F. J., & Bosch, M. (2006). Mathematical modelling as a tool for the connection of school mathematics. ZDM - International Journal on Mathematics Education, 38(3), 226–246. https://doi.org/10.1007/BF02652807

García González, M. S., & Sierra, G. M. (2020). The history of a teacher's relief of his mathematics anxiety: the case of Diego. Educational Studies in Mathematics, 103(3), 273–291. https://doi.org/10.1007/s10649-020-09941-8

Gurmu, F., Tuge, C., & Hunde, A. B. (2024). Effects of GeoGebra-assisted instructional methods on students' conceptual understanding of geometry. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2379745

Husain, A., Ikram, M., & Bahri, F. (2023). Analysis of students' proportional reasoning in solving story problems. International Journal of Progressive Mathematics Education, 3(1), 16–23. https://doi.org/10.22236/ijopme.v3i1.7619

Ikram, M., Purwanto, & Parta, I. N. (2021). Analysis of The Occurrence of Reversible Reasoning for Inverse Cases: A Case Study on The Subject Adjie. International Journal of Progressive Mathematics Education, 1(1), 1–15. https://doi.org/10.22236/ijopme.v1i1.6635

Istikomah, E., & Wahyuni, A. (2018). Student's Mathematics Anxiety on The Use of Technology in Mathematics Learning. JRAMathEdu (Journal of Research and Advances in Mathematics Education). https://doi.org/10.23917/jramathedu.v3i2.6364

Kamberi, M. (2025). The types of intrinsic motivation as predictors of academic achievement: the mediating role of deep learning strategy. Cogent Education, 12(1). https://doi.org/10.1080/2331186X.2025.2482482

Kenan, K. X.-F. (2017). Using Linear and Quadratic Functions to Teach Number Patterns in Secondary School. Australian Senior Mathematics Journal, 31(2), 42–52.

Kharisma, Purwanto, S. E., Nguyen, N. T. T., & Tran, T.-G. (2023). Kecemasan Matematika pada Siswa Kelas 9 SMP Berdasarkan Ada Tidaknya Keikutsertaan Kursus Online pada Pembelajaran Daring. International Journal of Progressive Mathematics Education, 3(1), 1–15. https://doi.org/10.22236/ijopme.v3i1.7802

Klang, E., Barash, Y., Levartovsky, A., Lederer, N. B., & Lahat, A. (2021). Differentiation between malignant and benign endoscopic images of gastric ulcers using deep learning. Clinical and Experimental Gastroenterology, 14, 155–162. https://doi.org/10.2147/CEG.S292857

Köğce, D. (2022). Examination of Mathematical Errors and Mistakes in Calculus Course. Educational Policy Analysis and Strategic Research, 17(1), 295–311. https://doi.org/10.29329/epasr.2022.248.15

Kurniasih, N., Hidayani, F., & Muchlis, A. (2021). Analisis Kemandirian Belajar Matematika Siswa SMA Kelas XI Selama Pembelajaran Jarak Jauh. International Journal of Progressive Mathematics Education, 1(2), 117–126. https://doi.org/10.22236/ijopme.v1i2.6568

Maarif, S., Umam, K., Soebagyo, J., & Pradipta, T. R. (2022). Critical review on mathematics virtual classroom practice in private university. International Journal of Nonlinear

Analysis and Applications, 13(1), 975–982. https://doi.org/10.22075/ijnaa.2022.5616

Melesse, T., & Belay, S. (2022). Differentiating instruction in primary and middle schools: Does variation in students' learning attributes matter? Cogent Education, 9(1). https://doi.org/10.1080/2331186X.2022.2105552

Miao, Y., Holst, S. J., Haake, J. M., & Steinmetz, R. (2020). PBL-protocols: Guiding and Controlling Problem Based Learning Processes in Virtual Learning Environments. International Conference of the Learning Sciences, 244–249. https://doi.org/10.4324/9780203763865-50

Nakawa, N., & Kosaka, M. (2025). Aligning Cross-Curricular Inquiry-Based High School Textbooks with Curriculum Guidelines. ZDM - Mathematics Education. https://doi.org/10.1007/s11858-025-01701-3

Nelvia, S. (2019). Implementasi Pendekatan Sosiolinguistik. Bahasa Indonesia, 17, 87–98.

Pepin, B., Kohanová, I., & Lada, M. (2025). Developing Pre-Service Teachers' Capacity for Lesson Planning with the Support of Curriculum Resources. ZDM - Mathematics Education. https://doi.org/10.1007/s11858-025-01685-0

Schindler, M., Simon, A. L., Baumanns, L., & Lilienthal, A. J. (2025). Eye-tracking research in mathematics and statistics education: recent developments and future trends. A systematic literature review. ZDM - Mathematics Education. https://doi.org/10.1007/s11858-025-01699-8

Shi, L., Muhammad Umer, A., & Shi, Y. (2023). Utilizing AI models to optimize blended teaching effectiveness in college-level English education. Cogent Education, 10(2). https://doi.org/10.1080/2331186X.2023.2282804

Stapleton, P. (2011). A survey of attitudes towards critical thinking among Hong Kong secondary school teachers: Implications for policy change. Thinking Skills and Creativity, 6(1), 14–23. https://doi.org/10.1016/j.tsc.2010.11.002

Tamami, M., Santi, V. M., & Aziz, T. A. (2021). Pengembangan Buku Ajar Matematika dengan Pendekatan Contextual Teaching And Learning (CTL) pada Materi Statistika untuk Siswa Kelas XI SMK Bisnis dan Manajemen. International Journal of Progressive Mathematics Education, 1(3), 207–217. https://doi.org/10.22236/ijopme.v1i3.7620

Tamami, M., Santi, V. M., & Aziz, T. A. (2023). Pengembangan Buku Ajar Matematika dengan Pendekatan Contextual Teaching And Learning (CTL) pada Materi Statistika untuk Siswa Kelas XI SMK Bisnis dan Manajemen. International Journal of Progressive Mathematics Education, 3(1), 24–34. https://doi.org/10.22236/ijopme.v3i1.7620

Umam, K., Nusantara, T., Parta, I. N., Hidayanto, E., & Mulyono, H. (2019). An application of flipped classroom in mathematics teacher education programme. International Journal of Interactive Mobile Technologies, 13(3). https://doi.org/10.3991/ijim.v13i03.10207

Winje, Ø., & Løndal, K. (2023). 'Wow! is that a birch leaf? In the picture it looked totally different': a pragmatist perspective on deep learning in Norwegian 'uteskole.' Education 3-13, 51(1), 142–155. https://doi.org/10.1080/03004279.2021.1955946