JESE 5 (1) (2025)

Journal of Environmental and Science Education

http://journal.unnes.ac.id/sju/index.php/jese

# Pre-service Teachers' Perceptions of the New Pedagogical Deep Learning (NPDL)

**Yeni Setyowati[1], Ayu Rahayul Prasetyo Listiaji[2]**

[1]Science Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia, 50229

[2]Doctoral School of Education, Faculty of Humanities and Social Sciences, University of Szeged, Hungary, 6720

**DOI: 10.15294/jese.v5i1.25274**

## Article Info

Received 2 Maret 2025
Accepted 15 April 2025
Published 28 April 2025

*Keywords:*
**Education for Sustainable Development, Environmental Pollution Learning, ESD Outcome, ESD Curricula, ESD Policy**

Corresponding Author:
**Yeni Setyowati**
Universitas Negeri Semarang
E-mail: yenis@mail.unnes.ac.id

## Abstract

This study aimed to investigate the perceptions of pre-service Science Education teachers regarding New Pedagogical Deep Learning (NPDL) in Indonesia. Employing a descriptive survey design, the research was conducted in Central Java Province and involved a sample of 88 pre-service Science Education teachers. Data collection was performed using a questionnaire consisting of 10 items, distributed through Google Forms, complemented by follow-up interviews. Quantitative data analysis utilizing a Likert scale was conducted by calculating the percentage of respondents for each response category to provide a descriptive representation of perception distribution. The study found that while Science Education pre-service teachers show interest and readiness to implement Deep Learning in the classroom, some hold misconceptions—such as equating it with AI—and need further training and ecosystem support to apply it effectively. This study introduces a novel perspective by elucidating science pre-service teachers' perceptions of NPDL, an area that has thus far received limited attention within the context of pre-service teacher education. The results indicate that the incorporation of NPDL into pre-service teacher education is required to strengthen the pedagogical readiness of future educators for the demands of 21st-century teaching and learning.


ISSN 2775-2518

## INTRODUCTION

Education in Indonesia is currently undergoing a transformation aimed at fostering learning that not only emphasizes knowledge acquisition but also prioritizes character development and the cultivation of 21st-century competencies. A central approach within the Merdeka Curriculum is Deep Learning, which emphasizes higher-order thinking, meaningful knowledge construction, and contextual learning that connects academic content with real-life situations (Labuem et al., 2021; Mustaghfirin & Zaman, 2025). The Center for Curriculum and Learning (Puskurjar) of the Ministry of Education, Culture, Research, and Technology defines Deep Learning as an approach that fosters a conscious, meaningful, and enjoyable learning environment through holistic engagement—cognitive, emotional, sensory, and physical (Diputera, 2024). Within this framework, teachers are no longer merely transmitters of information but serve as facilitators who encourage students to explore, reflect, and synthesize knowledge both inside and outside the classroom.

Globally, this approach aligns with the Deep Learning pedagogy theory developed through the New Pedagogies for Deep Learning (NPDL) initiative by Fullan et al. (2018), which promotes the development of six global competencies or 6Cs: Character, Citizenship, Collaboration, Communication, Creativity, and Critical Thinking (; Khotimah, et al, 2024; Arianda, et al, 2024). These competencies are considered essential for preparing students to meet the complexities of 21st-century life (Chalkiadaki, 2018). However, the implementation of this approach still faces significant challenges. A study by Putro et al. (2023) indicates that over 60% of teachers lack a clear understanding of the distinctions between pedagogical approaches such as active learning, project-based learning, and deep learning, resulting in misconceptions during implementation. Many teachers also continue to rely on lecture and memorization methods, which limits the development of students' critical thinking skills (Amirova, 2025).

This situation is further exacerbated by the low critical and reflective thinking abilities of Indonesian students, as evidenced by the 2018 PISA results, which ranked Indonesia low in literacy and numeracy (Dos Santos et al., 2023). Additionally, the lack of contextual and real-life relevance in learning makes it difficult for students to understand the significance of the education they receive (O'Neill & Short, 2025). Other challenges include low motivation and engagement in learning, particularly in the 3T regions (underdeveloped, frontier, and outermost), which have not yet been fully reached by innovative approaches such as Deep Learning (Ochwada, 2025).

In this context, the role of pre-service teachers becomes crucial as agents of change who integrate theoretical understanding and pedagogical practice into authentic and meaningful learning processes (Woodrow & Caruana, 2017). Through a combination of university-based learning and fieldwork in schools, pre-service teachers are expected to develop reflective skills, learning design competencies, and positive interactions with students (Ellis & Spendlove, 2020). The readiness of pre-service teachers to understand and effectively apply Deep Learning principles will significantly determine the success of future educational transformation.

However, to date, there remains a paucity of research specifically exploring pre-service teachers' perceptions of the Deep Learning approach, particularly within the context of the Merdeka Curriculum in Indonesia. Addressing this research gap is important for assessing the extent of pre-service teachers' readiness and understanding in adopting learning approaches that require a transformation in thinking and teaching practices.

This study aims to answer the question: What are pre-service teachers' perceptions of the concept and implementation of Deep Learning pedagogy within the context of 21st-century education?

The findings are expected to provide an initial overview of pre-service teachers' readiness to implement Deep Learning in schools, serve as a reference for the development of teacher education curricula, and support the creation of a learning ecosystem oriented toward strengthening character and global competencies.

## METHOD

This research employed a descriptive survey design combined with basic analytical methods to explore pre-service teachers' perceptions of New Pedagogical Deep Learning (NPDL). Descriptive survey research involves selecting a representative sample from a defined population and using standardized instruments—such as questionnaires—for data collection (Creswell, 2013). In this study, a simple random sampling technique was used to ensure that each participant had an equal probability of being selected from the population of pre-service science education teachers at a state university in Indonesia. A total of 88 respondents participated, consisting of 11.2% male and 88.8% female students, with distribution across semesters 2 to 6, reflecting a range of experiences in pedagogical coursework and school-based practicum.

The primary data were collected through a structured questionnaire using a 5-point Likert scale, which measured perceptions ranging from "Strongly Disagree" to "Strongly Agree." Data collected using a Likert scale were analyzed descriptively by calculating frequencies and percentages to illustrate respondents' perceptual tendencies regarding each statement item

In addition to the quantitative survey, semi-structured interviews were conducted with a subset of 10 participants, selected purposively to represent diverse levels of understanding and attitudes as indicated by survey results. This qualitative component aimed to deepen insight into respondents' interpretations of NPDL. The interview protocol consisted of open-ended questions designed to explore participants' conceptual understanding, practical experiences, and perceived challenges related to deep learning pedagogy.

The qualitative data were analyzed using thematic analysis, following Braun and Clarke's (2006) six-step approach: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. By combining quantitative and qualitative data sources, this study provides a more comprehensive and nuanced understanding of pre-service teachers' perceptions and readiness to implement NPDL within the evolving educational landscape.

## RESULT AND DISCUSSION

This study employed a questionnaire administered to a sample of 88 undergraduate students majoring in Science Education. The survey statement codes are presented in Table 1 below.

**Tabel 1. Statement Code**

| Code | Statement |
|---|---|
| A1 | I understand the concept of Deep Learning (NPDL) |
| A2 | I think Deep Learning is important for aspiring teachers |
| A3 | I am interested in implementing Deep Learning in the teaching and learning process |
| A4 | I believe that Deep Learning can improve students' understanding of the material |
| A5 | Lecturers in my study program have implemented Deep Learning in lectures |
| A6 | I am ready to implement Deep Learning when I become a teacher later |
| A7 | I need special training to understand and apply Deep Learning |
| A8 | I believe that Deep Learning can improve the quality of education in Indonesia |
| A9 | I feel that Deep Learning can be applied to all subjects |
| A10 | I'm having trouble understanding the concept of Deep Learning. |

Data obtained from the survey were subsequently analyzed using Likert scale analysis. The Likert scale analysis is a widely

employed psychometric method used to assess respondents' attitudes, opinions, or perceptions toward specific statements within social and educational research contexts. In this study, a 5-point Likert scale was utilized, consisting of the following response options: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. The inclusion of a neutral midpoint option provides flexibility in measurement and enhances both the reliability and validity of the instrument. This scale enables researchers to capture varying degrees of agreement or disagreement, facilitating quantitative analysis of subjective variables (Kusmaryono et al., 2022).

In this descriptive survey study, quantitative data analysis was employed utilizing a descriptive methodology. The questionnaire responses, originally measured on an ordinal scale, were converted into an interval scale based on the Markov Monte Carlo theory as proposed by Granberg-Rademacker (2010). Quantitative data processing was conducted using Microsoft Excel software, with the analysis primarily focusing on the computation of means, percentage distributions, and subsequent data interpretation.

A primary limitation of this analysis lies in the interpretation of Likert scale data, which are inherently ordinal and do not technically represent equal intervals between scale points (Boone & Boone, 2021). Although descriptive statistics such as percentages and means are commonly employed, this approach is limited in revealing deeper meaning, as it assumes that the differences between categories (for example, between "agree" and "strongly agree") carry equal weight (Joshi et al., 2015). Without validated conversion to an interval scale—such as through the Rasch model or simulation-based procedures like Monte Carlo—quantitative interpretation may be inaccurate unless accompanied by technical justification (de Winter & Dodou, 2016). Therefore, results obtained from ordinal data such as Likert scales should be considered indicative and should be complemented by qualitative approaches to provide a more comprehensive and contextual understanding of the phenomenon under investigation (Vasileiou et al., 2018).

## Understanding of Deep Learning (NPDL)

Data from the perception analysis of pre-service teachers toward Deep Learning (NPDL) can be observed in the graph presented in Figure 1.

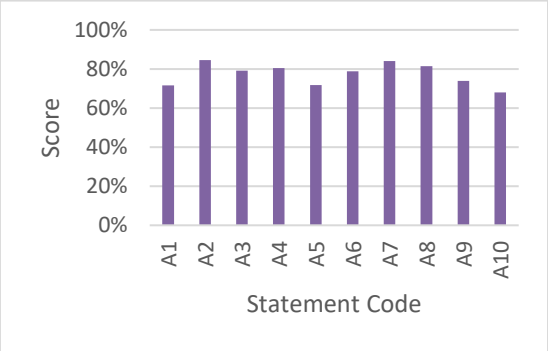


**Figure 1. Pre-Service Teachers Perception Result**

Survey data revealed that 72% of students reported understanding the concept of Deep Learning. However, follow-up interviews indicated that 16% of these respondents associated Deep Learning with artificial intelligence (AI) technology rather than recognizing it as a pedagogical approach. Meanwhile, only approximately 65% accurately understood Deep Learning as a contextual, meaningful, and conscious learning methodology. The remaining 19% admitted unfamiliarity with the term.

This disparity in understanding highlights a significant conceptual gap among pre-service teachers. Students who had completed courses on instructional strategies and teaching practicums demonstrated greater familiarity with the pedagogical context of Deep Learning. Conversely, early-semester students or those lacking teaching experience were more likely to conflate the term with AI concepts, as "deep learning" is more commonly encountered in digital technology contexts.

*"Deep learning is a concept in AI, specifically a subfield of machine learning" (Respondent 79, Semester 2).*

This underscores the necessity for explicit terminological clarification within teacher education curricula to mitigate conceptual ambiguity and ensure pedagogical fidelity.

## Perceptions of Deep Learning (NPDL)

Approximately 80% of students believe that Deep Learning can enhance learners' comprehension of subject matter, and 81% agree that this approach has the potential to improve the quality of education in Indonesia. These findings align with international literature indicating that Deep Learning promotes the development of critical thinking, reflective skills, and deep understanding of content (Nguyen et al., 2020).

However, a comparison between students who possess a clear understanding of the Deep Learning concept and those who hold misconceptions reveals that the former group tends to perceive the benefits of Deep Learning more positively and exhibits greater enthusiasm toward its implementation. One student remarked:

"Yes, implementation is important because it helps students think critically, better understand the material, and prepares them for real-world challenges, not just for exams." *(Respondent 6, Semester 4).*

This suggests that positive perceptions regarding the effectiveness of Deep Learning are significantly influenced by the depth of conceptual understanding.

## Readiness for Implementing Deep Learning

Approximately 72% of students reported that their lecturers have implemented the Deep Learning approach in the course delivery process. This finding indicates that teacher education institutions (LPTKs) have begun integrating innovative pedagogical methods into their teaching practices, albeit not yet in a fully systematic manner.

Students with direct experience of Deep Learning-based instructional models tend to demonstrate higher levels of understanding and readiness. They are able to describe activities such as reflection, problem-based learning, and collaboration within the classroom as part of their learning experiences.

"*In the Bioenergy class, the lecturer often assigns case studies and group discussions, which they said are part of Deep Learning." (Respondent 20, semester 6)*

However, not all students reported similar experiences, suggesting variability in the implementation of Deep Learning across different lecturers.

Among all respondents, 79% expressed readiness to apply Deep Learning when they become teachers, and 84% indicated a need for specialized training to effectively implement this approach. As agents of change and key actors in efforts to improve the quality of education in Indonesia, pre-service teachers demonstrate strong motivation to embrace and apply Deep Learning in their teaching practices (Savitri, 2020). Comparative analysis reveals that students who claim to understand the Deep Learning concept and have experienced its practice in coursework exhibit greater confidence and preparedness.

Conversely, students lacking comprehensive conceptual understanding express doubts and concerns regarding implementation in real-world settings, particularly within schools that may not support pedagogical innovation. These findings are consistent with the work of Algozhaeva and Zhumabekova (2021), who emphasize the critical importance of readiness and targeted training for pre-service teachers in adopting 21st-century competency-based instructional innovations.

This variation in understanding illustrates that the concept of Deep Learning, recently introduced by the Ministry of Education and Culture, is still interpreted diversely among pre-service science teachers. Therefore, there is a critical need for more extensive education and systematic dissemination to correct misconceptions about Deep Learning, which fundamentally incorporates principles of mindfulness, meaningfulness, and joyfulness within the

humanistic educational context. This finding aligns with Wijaya's (2025) study, which identified that comprehension of Deep Learning in educational practice remains limited. The Ministry's emphasis on Deep Learning as a transformative pedagogical approach aims to foster higher-order thinking, reflection, and contextualized learning, moving beyond rote memorization toward active, meaningful engagement (Kementerian Pendidikan Dasar dan Menengah Republik Indonesia, 2025). Addressing these gaps through targeted training and curriculum development is essential to ensure effective implementation and to realize the potential benefits of Deep Learning in improving educational quality in Indonesia.

Deep Learning is not merely a method but a transformational framework that positions students as active agents in their own learning, aligning with the vision of the Merdeka Curriculum and the demands of global competencies (Mthethwa-Kunene, 2022). Based on the research by Fahrisa and Parmin (2022), the implementation of innovative learning approaches can enhance students' critical and creative thinking skills. This approach requires teachers to act as facilitators who guide students in critically and creatively exploring learning concepts, thereby making learning more meaningful and relevant to 21st-century needs (Hmelo-Silver et al., 2007). Lissa'adah & Widiyatmoko (2023) also assert that enjoyable learning environments significantly enhance student engagement and active participation.

Active and meaningful learning is critical because this method facilitates deeper student comprehension and engagement throughout the learning process (Tsai, 2020; Zhao, et al, 2022). Furthermore, meaningful learning increases students' motivation and interest, as they perceive themselves to have an active role and responsibility in the learning process, which positively impacts long-term knowledge retention and the achievement of optimal learning outcomes (Hsbollah & Hassan, 2022; Johansen, et al, 2023).

Although understanding of Deep Learning remains varied, pre-service teachers demonstrate a notably high level of awareness, interest, and motivation to implement this approach. As established by Ummayah & Dewi (2021), research findings indicate that enjoyable learning experiences can significantly enhance student learning outcomes. This constitutes a crucial foundation for the transformation of national education. However, without robust conceptual understanding and sufficient practical support, there is a risk that the implementation of Deep Learning will remain superficial or merely rhetorical.

A comprehensive reform of the teacher education curriculum is required to integrate Deep Learning across all core pedagogical courses, alongside systematic training programs grounded in authentic school-based practice. Additionally, the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) should develop clear, accessible, and practical technical guidelines to minimize misconceptions and errors in the application of this concept in the field (Jukić & Kakuk, 2019). Such measures are essential to ensure that Deep Learning is implemented effectively and consistently throughout the education system.

The implementation of Deep Learning in Indonesia requires comprehensive socialization efforts that extend beyond teachers to include pre-service teachers, who serve as agents of change in educational practice. The government should organize and collaborate with academic programs to equip pre-service science teachers with the necessary knowledge and skills to effectively apply Deep Learning in science instruction when they enter the classroom.

Findings from this study provide valuable insights for the Indonesian Ministry of Education and all educational practitioners, highlighting the importance of targeted training and systemic dissemination to ensure a shared understanding and successful adoption of Deep Learning across

educational levels. This approach aligns with ongoing initiatives by Kemendikdasmen and higher education institutions to promote innovative, meaningful, and student-centered learning practices nationwide.

## CONCLUSION

Based on the aforementioned discussion, several conclusions can be drawn. First, the level of understanding of pre-service teachers regarding the concept of Deep Learning still needs to be improved. The findings indicate that pre-service teachers' comprehension of Deep Learning (NPDL) remains varied. Some respondents still associate Deep Learning with artificial intelligence (AI) technology, while only a portion correctly understand it as a pedagogical approach emphasizing meaningful, conscious, and contextual learning. Second, deep learning is perceived as a solution to current student learning challenges. Third, pre-service teachers are ready to implement Deep Learning and require strong ecosystem support.

These findings have several important implications. At the policy level, there is a need for the Ministry of Education and related stakeholders to integrate Deep Learning more explicitly into the national teacher education curriculum, accompanied by clear operational guidelines and structured professional development programs for both pre-service and in-service teachers. For future research, longitudinal and mixed-method studies are recommended to explore how pre-service teachers' understanding and application of Deep Learning evolve during teaching practice and after entering the profession. Practically, LPTKs (Teacher Education Institutions) should revise their learning design by embedding Deep Learning principles across pedagogical courses, providing authentic, school-based learning experiences, and fostering reflective practices that align with 21st-century educational demands.

## REFERENCES

Algozhaeva, N., & Zhumabekova, K. (2021). Technologies of formation of teachers' readiness for innovative activity. Вестник КазНУ. Серия педагогическая, 67(2), 4-10.

Arianda, Y. D., Kamal, I., Supriadi, W., Mahdiyah, M., & Sarifah, I. (2024). Trends in Project Based Learning Models in Increase 6C Skills (Character, Citizenship, Critical Thinking, Creative, Collaborative, and Communication). *Jurnal Penelitian Pendidikan*, 41(2).

Boone, W. J., & Boone, D. A. (2021). Analyzing Likert Data. Journal of Extension, 59(2).

Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. International Journal of Instruction, 11(3), 1-16.

Creswell, J. W. (2013). Research design: Qualitative, quantitative and mixed methods (p. 273). Sage Publication.

de Winter, J. C. F., & Dodou, D. (2016). Five-Point Likert Items: t test versus Mann-Whitney-Wilcoxon. Practical Assessment, Research, and Evaluation, 21(1), Article 11.

Diputera, A. M. (2024). Memahami Konsep Pendekatan Deep Learning dalam Pembelajaran Anak Usia Memahami Konsep Pendekatan Deep Learning dalam Pembelajaran Anak Usia Dini Yang Meaningful , Mindful dan Joyful: Kajian Melalui Filsafat Pendidikan. December.

Ellis, V., & Spendlove, D. (2020). Mediating 'School Direct': The enactment of a reform policy by university-based teacher educators in England. British Educational Research Journal, 46(5), 949-966.

Fahrisa, N., & Parmin, P. (2022). Creative Problem Solving (CPS) learning to improve ability an strudent's critical and creative thinking on science materials. Journal of Environmental and Science Education, 2(2), 98-105.

Fullan, M., Quinn, J., & McEachen, J. (2018). Praise for Deep Learning: Engage the

World Change the World. Corwin. Ontario Principals Council. https://doi. org/https://lccn. loc. Gov.

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark. Educational Psychologist, 42(2), 99–107.

Hsbollah, H. M., & Hassan, H. (2022). Creating meaningful learning experiences with active, fun, and technology elements in the problem-based learning approach and its implications. Malaysian Journal of Learning and Instruction (MJLI), 19(1), 147-181.

Johansen, M. O., Eliassen, S., & Jeno, L. M. (2023). "Why is this relevant for me?": Increasing content relevance enhances student motivation and vitality. Frontiers in Psychology, 14, 1184804.

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Likert Scale: Explored and Explained. British Journal of Applied Science & Technology, 7(4), 396–403.

Jukić, R., & Kakuk, S. (2019). Socialization role of school and hidden curriculum. In EDULEARN19 Proceedings (pp. 3404-3412). IATED.

Kementerian Pendidikan Dasar dan Menengah Republik Indonesia. (2025). Pembelajaran mendalam - Transformasi pembelajaran menuju pendidikan bermutu untuk semua (Naskah akademik). Tim Penyusun: Suyanto, M.Ed., Ph.D. (Ketua) dkk.

Khotimah, S., Bambang, B., Purwati, A. S., & Aysi, S. A. H. (2023). Enhancing The 6Cs as 21st Century Skills Among Higher Education Students Through An Entrepreneurial Project Learning. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran*, 9(1).

Kusmaryono, I., Wijayanti, D., & Maharani, H. R. (2022). Number of response options, reliability, validity, and potential bias in the use of the Likert scale education and social science research: A literature review. International Journal of Educational Methodology, 8(4), 625-637.

Labuem, W. N.-M. Y.-S., Al Mansur, D. W. A.-M., Masgumelar, H. A.-N. K., Wijayanto, A., Or, S., Kom, S., Anggaira, A., Bayu, W. I., Amiq, F., & Or, S. (2021). Implementasi dan problematika merdeka belajar. Tulungagung: Akademia Pustaka.

Lissa'adah, L., & Widiyatmoko, A. (2023). The effectiveness of augmented reality based on Assemblr Edu to increase learning interest and student learning outcomes. Journal of Environmental and Science Education, 3(2), 79-85.

Mthethwa-Kunene, K., Rugube, T., & Maphosa, C. (2022). Rethinking pedagogy: Interrogating ways of promoting deeper learning in higher education. European Journal of Interactive Multimedia and Education, 3(1), e02204.

Mustaghfirin, U. A., & Zaman, B. (2025). Tinjauan Pendekatan Pembelajaran Mendalam Kemdikdasmen Perspektif Pendidikan Islam. Journal of Instructional and Development Researches, 5(1), 75–85.

Nguyen, T., Murphy, A., & Baker, R. (2020). Deep learning in education: A review of recent advances and challenges. Computers & Education, 147, 103788.

O'Neill, G., & Short, A. (2025). Relevant, practical and connected to the real world: what higher education students say engages them in the curriculum. Irish Educational Studies, 44(1), 23-40.

Putro, A. N. S., Wajdi, M., Siyono, S., Perdana, A. N. C., Saptono, S., Fallo, D. Y. A., Khoirotunnisa, A. U., Ningtyas, Kma. W. A., Leuwol, F. S., & Pationa, S. B. (2023). Revolusi Belajar Di Era Digital. Penerbit PT Kodogu Trainer Indonesia.

Savitri, D. I. (2020). Tantangan mahasiswa calon guru SD Universitas Borneo Tarakan pasca PPL di kawasan perbatasan dalam menghadapi era digital dan merdeka belajar. Jurnal

Pendidikan Dasar Borneo (Judikdas Borneo), 2(1), 103-110.

Tsai, M. C., Shen, P. D., Chen, W. Y., Hsu, L. C., & Tsai, C. W. (2020). Exploring the effects of web-mediated activity-based learning and meaningful learning on improving students' learning effects, learning engagement, and academic motivation. Universal Access in the I

Ummayah, F. F. D., & Dewi, N. R. (2021). Analysis of students metacognition ability through problem based learning assisted by worksheets on environmental pollution material. Journal of Environmental and Science Education, 1(2), 32-40.nformation Society, 19, 783-798.

Vasileiou, K., Barnett, J., Thorpe, S., & Young, T. (2018). Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. BMC Medical Research Methodology, 18, 148.

Wijaya, M. (2025). Kurikulum Deep Learning di Indonesia; Sebuah Harapan Baru. Jurnal Ilmiah Pendidikan Scholastic, 9(1), 10-15.

Woodrow, K., & Caruana, V. (2017). Preservice teachers' perspective transformations as social change agents. Journal of Transformative Education, 15(1), 37-58.

Zhao, X., Liu, M., & Liu, Y. (2022). The Influence of Different Learning Strategies on Pupils' Learning Motivation: Is Augmented Reality Multimedia Learning Consistent With Traditional Text Learning? Frontiers in Psychology, 13, 810345.