



Strengthening Responsible AI Literacy through TPACK and Prompt Engineering Training for High School Teachers to Enhance Digital Pedagogical Competence at SMA At Thohiriyyah, Semarang

Amiq Fahmi*, Edi Sugiarto, Y. Tyas Catur Pramudi, Edy Mulyanto

Faculty of Computer Science, Universitas Dian Nuswantoro Semarang, Indonesia.

*Corresponding Author. Email: amiq.fahmi@dsn.dinus.ac.id

Abstract: This community service program aims to enhance the Responsible AI Literacy of high school teachers at SMA At Thohiriyyah, Semarang City, in alignment with the Indonesian Joint Decree of Seven Ministers (SKB 7 Menteri), which emphasizes strengthening teachers' digital and pedagogical competencies in the era of AI-driven education. The program was implemented through In-House Training (IHT) based on the Technological Pedagogical and Content Knowledge (TPACK) framework and Prompt Engineering, involving 18 teachers. The implementation consisted of three stages—preparation, implementation, and evaluation—and employed pre-test and post-test instruments complemented by qualitative observations. Data were analyzed using quantitative and qualitative approaches, with triangulation applied to enhance the validity of the findings. The results showed a substantial improvement, with the average pre-test score increasing from 72.3 to 93.6 in the post-test, representing a 29.4% improvement. Qualitative findings indicated that participants actively engaged in discussions, hands-on practice, and reflective activities, and successfully developed AI-assisted teaching modules, student worksheets, and assessment instruments that support the deep learning paradigm. These findings suggest that TPACK- and Prompt Engineering-based In-House Training was effective in strengthening teachers' Responsible AI Literacy across technical, pedagogical, and ethical dimensions and has the potential to be adopted as a sustainable professional development strategy for educators in the digital era.

Article History:

Received: 20-05-2026

Reviewed: 27-06-2026

Accepted: 14-07-2026

Published: 20-08-2026

Key Words:

In House Training;
Kurikulum Merdeka;
Prompt Engineering;
Responsible AI Literacy;
TPACK.

How to Cite: Fahmi, A., Sugiarto, E., Pramudi, Y. T. C., & Mulyanto, E. (2026). Strengthening Responsible AI Literacy through TPACK and Prompt Engineering Training for High School Teachers to Enhance Digital Pedagogical Competence at SMA At Thohiriyyah, Semarang. *Jurnal Pengabdian UNDIKMA*, 7(3), 842-852. <https://doi.org/10.33394/jpu.v7i3.20779>



<https://doi.org/10.33394/jpu.v7i3.20779>

This is an open-access article under the [CC-BY-SA License](#).



Introduction

The development of digital technologies over the past decade has brought about a major transformation in education. One of the most significant milestones is the emergence of Generative Artificial Intelligence, such as ChatGPT, Google Gemini, and Microsoft Copilot, which are capable of producing texts, ideas, and solutions automatically (Gowda, 2023). These technologies function not only as writing assistants but also as intelligent automation tools that enhance teacher productivity and facilitate more adaptive personalization of learning compared to traditional approaches (Asy'ari & Sharov, 2024; Salih et al., 2025). With such potential, artificial intelligence offers schools the opportunity to accelerate the preparation of teaching materials, enrich the variety of learning activities, and provide more accurate data-driven formative assessments.



However, these benefits can only be optimized if teachers possess Responsible AI Literacy, defined as the ability to understand, critically evaluate, and use artificial intelligence ethically, safely, and accountably (Ding & Magerko, 2026). Without adequate competence, the use of AI risks becoming superficial, generating biased content, or even adding to teachers' administrative burdens (Muttaqin, 2022; Novita, 2025). This condition is evident at SMA At Thohiriyah, Semarang City (Kemdikbud, 2024), a senior high school accredited with grade B, consisting of 18 teachers and 120 students. Despite the institution's vision of producing graduates with strong character and technological adaptability, initial observations revealed that 78% of teachers remain at the basic stage of AI utilization, primarily confined to administrative tasks, information retrieval, and multiple-choice test construction. In contrast, more advanced pedagogical applications, such as developing teaching modules, adaptive assessments, and project-based learning, are still rarely implemented.

The urgency of strengthening Responsible AI Literacy becomes more apparent when linked to the implementation of the Kurikulum Merdeka (Nur & Susiawati, 2025), which emphasizes creativity, instructional flexibility, and technological capacity to support differentiated learning (Anggraini & Syamsurizal, 2025). Furthermore, the Ministry of Education through the Directorate General of Primary and Secondary Education highlights deep learning as the paradigm for 21st-century education (Rohmah, 2025), focusing on deep understanding, critical thinking, collaboration, and creativity. In the National Education Day address on May 2, 2026, the Director General reaffirmed that "Deep Learning is a priority program to improve the quality of education" (Suwanti, 2026). This transformation aims to build Indonesian citizens who are excellent, resilient, and dignified, thereby realizing a developed nation.

National policy through the Joint Decree of Seven Ministers in 2026 on the Guidelines for the Utilization and Learning of Digital Technology and Artificial Intelligence in Formal, Nonformal, and Informal Education (Ditbalnak, 2026) further asserts that the use of digital technology and AI in schools must be ethical, safe, wise, and responsible. The document explicitly states: "The utilization of digital technology and artificial intelligence in educational institutions must consider child protection." It must also ensure "balance between digital and non-digital activities and collaboration with parents and communities". Thus, teacher mentoring in Responsible AI Literacy is not merely a technical necessity but also a national policy mandate to build an ethical and accountable digital school ecosystem.

The gap identified at SMA At Thohiriyah lies in the presence of significant potential that is not yet matched by teachers' actual competencies. While teacher enthusiasm is relatively high, the lack of intensive training, limited pedagogical mentoring, and the absence of ready-to-use AI-based learning tools remain major obstacles. Teachers expressed the need to learn how to design teaching modules, formative assessments, and interactive AI-based learning media. This condition underscores the importance of community service programs designed not only as one-way training but also as systematic mentoring through In-House Training (IHT), integrating the Technological Pedagogical and Content Knowledge (TPACK) framework (Hidayat et al., 2023; Mondal, 2023) and Prompt Engineering (Qian, 2025) as pedagogical foundations. The integration of TPACK and Prompt Engineering within the IHT framework provides significant advantages, as this approach is expected to effectively address the challenges of ethical AI literacy at the school.

Moreover, this initiative aligns with the Merdeka Belajar–Kampus Merdeka (MBKM) policy and the Key Performance Indicators (IKU) of higher education (Herianto et al., 2024), particularly IKU-2, which emphasizes collaborative and innovative learning, and IKU-5,



which highlights lecturers' contributions to society and partner educational institutions. Supported by these frameworks, the program is expected not only to enhance teachers' skills but also to contribute to the strengthening of an innovative, ethical, and sustainable learning ecosystem. Specifically, the purpose of this community service is to empower teachers with practical competencies in AI-based pedagogy, while its contribution lies in fostering ethical AI literacy and promoting a culture of innovation within the school environment.

Method



Figure 1. The IHT Model of Responsible AI Literacy for Teachers at SMA At Thohiriyyah

This community service initiative was conducted through an intensive mentoring approach based on In-House Training (IHT), integrating the Technological Pedagogical and Content Knowledge (TPACK) framework (Hidayat et al., 2023; Mondal, 2023) and Prompt Engineering (Qian, 2025). This approach was selected to meet the specific needs of teachers at SMA At Thohiriyyah, who required practical, structured, and continuous training to strengthen their Responsible AI Literacy (Ding & Magerko, 2026).

The IHT model facilitates direct interaction between facilitators and teachers, ensuring that knowledge transfer extends beyond lectures to include hands-on practice, collaborative discussion, and reflective sessions. Consequently, teachers gain contextual and applicable learning experiences, enabling them to develop AI-based instructional materials that align with the Kurikulum Merdeka. Importantly, all 18 participating teachers represented diverse subject areas, including STEM, humanities, and local Islamic studies, and the pre-test and post-test assessments encompassed the entire population of these participants, thereby ensuring comprehensive and valid evaluation of the program's effectiveness. Figure 1



illustrates the sequence of activities within the IHT framework, covering preparation, implementation, and evaluation stages.

Stages of Implementation

- 1) Preparation
 - a) Development of training materials and evaluation instruments based on the TPACK framework and AI literacy principles.
 - b) Validation of pre-test and post-test items by the Community Service Team and the Vice Principal for Curriculum Affairs.
 - c) Coordination with the school regarding scheduling and technical arrangements.
- 2) IHT Implementation
 - a) Stage 1: Socialization of the Joint Decree of Seven Ministers (2026) concerning policies on the utilization of digital technology and artificial intelligence in educational institutions (Ditbalnak, 2026).
 - b) Stage 2: Introduction to TPACK (Hidayat et al., 2023; Mondal, 2023) and Prompt Engineering (Qian, 2025), including techniques for constructing precise prompts to generate AI outputs relevant to learning contexts (Dana et al., 2026).
 - c) Stage 3: Practice in developing AI-based learning media, where teachers were trained to design teaching modules, student worksheets, formative assessments, and multimedia content supporting the deep learning paradigm and the Kurikulum Merdeka.
- 3) Evaluation
 - a) Pre-test: Twenty multiple-choice questions measuring teachers' initial knowledge of AI literacy, the Joint Decree of Seven Ministers (Ditbalnak, 2026), and basic prompt engineering skills (Dana et al., 2026).
 - b) Post-test: Twenty multiple-choice questions assessing improvement in teachers' understanding and practical skills.
 - c) Participation Observation: Recording teachers' engagement in discussions, practice sessions, and reflective activities.
- 4) Data Analysis
 - a) Quantitative Analysis: Examination of average pre-test and post-test scores, percentage improvement, and distribution across categories (low, medium, high) (Rojabi, 2025). The classification into low, medium, and high categories followed the interval formula based on mean and standard deviation (Hidayatullah & Shadiqi, 2020; Rojabi, 2025), where scores were divided into three equal intervals: Low ($X \leq \text{Mean} - 1 \text{ SD}$), Medium ($\text{Mean} - 1 \text{ SD} < X \leq \text{Mean} + 1 \text{ SD}$), and High ($X > \text{Mean} + 1 \text{ SD}$).
 - b) Qualitative Analysis: Narrative interpretation of field observations and documentation of teachers' practices (Setiyani et al., 2026).
 - c) Triangulation Analysis: Integration of test results and observational data to strengthen validity (Nurfajriani et al., 2024).
- 5) Validity and Contribution
 - a) Instruments were validated collaboratively by the Community Service Team and the Vice Principal for Curriculum Affairs.
 - b) Mentoring was conducted through a collaborative approach, with facilitators acting as partners to the teachers.
 - c) The outcomes included high-quality, ethical, and accountable AI-based learning materials, along with enhanced Responsible AI Literacy among teachers that supports



deep learning and contributes to higher education performance indicators (IKU-2 and IKU-5).

Result and Discussion

Pre-test and Post-test Results

The IHT program based on the TPACK framework and Prompt Engineering was attended by 18 teachers from SMA At Thohiriyyah. Evaluation was conducted through a pre-test and post-test, each consisting of 20 multiple-choice items designed to measure Responsible AI Literacy, understanding of the Joint Decree of Seven Ministers (SKB 7 Menteri), and basic skills in constructing effective prompts. The results demonstrated a significant improvement. Prior to the training, the average pre-test score was 72.3, indicating that teachers' initial level of understanding fell within the "good" category. Following the training, the average post-test score increased to 93.6, which is categorized as "very good." The 29.4% improvement confirms that the training had a tangible impact on enhancing teachers' competencies. Table 1 presents the detailed pre-test and post-test scores of each participant, showing a consistent trend of improvement across all teachers.

Table 1. Pre-test and Post-test Scores of Teachers at SMA At Thohiriyyah

No	Teacher's Name	Pre-test Score	Post-test Score	Improvement (%)
1	Teacher A	70	92	31.4
2	Teacher B	74	95	28.4
3	Teacher C	71	94	32.4
4	Teacher D	73	93	27.4
5	Teacher E	72	94	30.6
6	Teacher F	71	92	29.6
7	Teacher G	73	95	30.1
8	Teacher H	74	94	27.0
9	Teacher I	72	93	29.2
10	Teacher J	71	94	32.4
11	Teacher K	73	95	30.1
12	Teacher L	72	93	29.2
13	Teacher M	74	94	27.0
14	Teacher N	71	92	29.6
15	Teacher O	73	95	30.1
16	Teacher P	72	94	30.6
17	Teacher Q	71	93	31.0
18	Teacher R	73	95	30.1
Average		72.3	93.6	29.4

Quantitative Analysis

The quantitative analysis indicates that prior to the training, the majority of teachers (70%) were categorized as good, with the remaining classified as moderate (20%) and very good (10%). To strengthen the validity of this categorization, the classification into low, medium, and high categories was based on the interval formula, where scores were divided according to the mean and standard deviation: Low ($X \leq \text{Mean} - 1 \text{ SD}$), Medium ($\text{Mean} - 1 \text{ SD} < X \leq \text{Mean} + 1 \text{ SD}$), and High ($X > \text{Mean} + 1 \text{ SD}$). After the training, the distribution of scores shifted significantly: 80% of teachers were classified as very good, while the remaining 20% were categorized as good. This shift demonstrates a clear progression in teachers' competencies, moving from a predominance in the good category to a clear dominance in the very good category.



The comparison of average pre-test and post-test scores is presented in Figure 2, which clearly illustrates an improvement from 72.3 to 93.6. The blue bar represents the pre-test scores, while the green bar indicates the post-test scores. This chart confirms that the training based on the TPACK framework and Prompt Engineering effectively enhanced teachers' Responsible AI Literacy in a significant manner. Furthermore, the statistical test results (paired t-test) revealed a significant difference between the pre-test and post-test scores ($p < 0.05$). This finding reinforces the evidence that the TPACK- and Prompt Engineering-based training was effective in improving teachers' Responsible AI Literacy.

Comparison of Average Pre-test and Post-test Scores

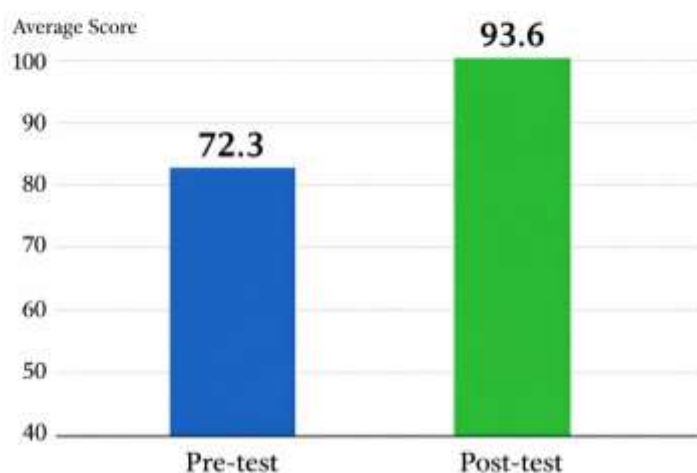


Figure 2. Comparison of Average Pre-test and Post-test Scores of Teachers at SMA At Thohiriyyah

Trend of Pre-test and Post-test Score Improvement among 18 Teachers at SMA At Thohiriyyah

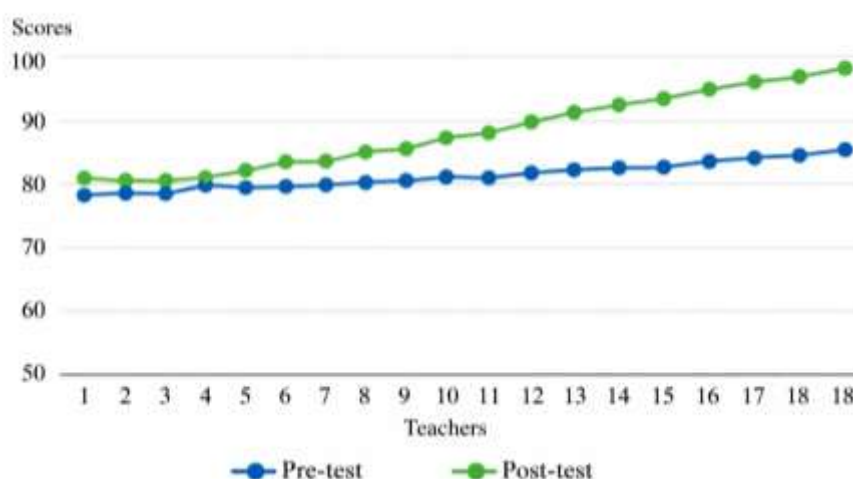


Figure 3. Trend of Pre-test and Post-test Score Improvement of 18 Teachers at SMA At Thohiriyyah

The trend of individual score improvement is displayed in Figure 3, showing that all participants experienced an increase in their scores from pre-test to post-test. The blue line represents relatively stable pre-test scores within the range of 70–74, whereas the green line shows consistently higher post-test scores ranging from 92–95. No decline was observed



among participants, indicating that all teachers demonstrated improved understanding and skills following the training.

Qualitatively, the observation results indicate that teachers demonstrated a high level of enthusiasm throughout the training sessions. During the introduction to TPACK and Prompt Engineering, discussions were notably active, with teachers sharing experiences and attempting to construct prompts aligned with their respective instructional contexts. In the AI-based media practice sessions, teachers successfully developed interactive teaching modules, student worksheets, and formative assessments. The collective reflection revealed that teachers began to comprehend how artificial intelligence can be ethically and meaningfully integrated into the Merdeka Curriculum, supporting the paradigm of deep learning.



Figure 4. Implementation of IHT Activities and Contribution of AI-Based Learning Materials

Figure 4 illustrates the implementation of the IHT activities and the contribution of AI-based learning materials developed by teachers. The figure highlights how the training sessions fostered active engagement, resulting in the production of interactive modules, student worksheets, and formative assessments. These outputs demonstrate that teachers were not only able to grasp the concepts introduced but also to apply artificial intelligence ethically and contextually within the framework of the Merdeka Curriculum.

Discussion

The findings show that the IHT approach based on TPACK and Prompt Engineering was effective in improving the Responsible AI Literacy of teachers at SMA At Thohiriyah. The improvement can be attributed to several factors. First, the integration of TPACK ensured that technological tools were aligned with pedagogical strategies and subject content, making the training more relevant and applicable to classroom practice (Diamah et al., 2022). Second, the use of Prompt Engineering provided teachers with structured guidance in interacting with AI systems, which enhanced their confidence and ability to apply Responsible AI principles (Azis et al., 2026). Moreover, the collaborative training environment encouraged peer learning and reflection, further reinforcing the adoption of new skills (Muryati et al., 2025). These factors collectively explain the significant progression in teachers' competencies, shifting their performance from the "good" category to the "very good" category.

The involvement of the community service team together with the Vice Principal for Curriculum Affairs in instrument validation strengthened the accountability of the program



and ensured its alignment with the school's needs. This emphasizes that the success of the training was not only determined by the content delivered but also by the collaborative mechanism established between facilitators and teachers. From a qualitative perspective, teachers demonstrated strong enthusiasm during discussions, practice sessions, and reflections. The outputs in the form of AI-based teaching modules, student worksheets, and formative assessments revealed that teachers not only understood the concepts but were also able to apply technology ethically and contextually within the framework of the Merdeka Curriculum. This is consistent with national policy directions that highlight the responsible use of digital and artificial intelligence technologies and support the paradigm of deep learning, which emphasizes comprehensive understanding, collaboration, creativity, and critical reflection.

The success of this training further suggests that the intensive mentoring model can be replicated in other schools as a strategy for teacher professional development. This is relevant to the objectives of the Merdeka Belajar policy and the Key Performance Indicators (IKU) for higher education institutions, particularly IKU-2 (collaborative and innovative learning) and IKU-5 (faculty contribution to partner schools and communities). Therefore, this initiative not only enhanced teacher competence but also contributed meaningfully to the strengthening of an ethical, innovative, and sustainable national education ecosystem.

Based on both quantitative and qualitative results, it can be affirmed that the IHT approach grounded in TPACK and Prompt Engineering was effective in enhancing the Responsible AI Literacy of teachers at SMA At Thohiriyyah. The increase in average scores from 72.3 to 93.6, representing a 29.4% improvement, demonstrates a transformation of competence from the "fairly good" category to the "very good" category. From a qualitative perspective, teachers actively engaged in discussions, practice sessions, and reflections, and produced AI-based learning materials that were ethical and relevant to the Merdeka Curriculum (Nur & Susiawati, 2025). Therefore, this intensive mentoring model not only strengthened teachers' technical, pedagogical, and ethical skills but also supported the paradigm of deep learning. The model can be replicated as a professional development strategy for teachers in the digital era.

Conclusion

The IHT program based on TPACK and Prompt Engineering was proven effective in significantly improving teachers' Responsible AI Literacy, as demonstrated by the increase in the average score from 72.3 to 93.6 (a gain of 29.5%). The improvement was evident not only in the quantitative score gains but also in the active involvement of teachers during practice and reflection sessions. The outputs in the form of AI-based learning materials demonstrated that teachers were able to integrate artificial intelligence ethically and contextually into the Merdeka Curriculum. This model not only provided positive impacts at the local level but also holds potential as a validated reference for strengthening teacher AI literacy at the national and international levels, with measurable improvements in competencies and scalable potential for broader adoption.

Recommendation

- **For the School (SMA At Thohiriyyah):** The outcomes of the training should be utilized as valuable input for internal school policy development, particularly in integrating Responsible AI Literacy into the broader school curriculum and professional development agenda. Periodic training programs should be institutionalized to ensure sustainability.



- **For Teachers:** Similar training should be conducted regularly with broader coverage, involving diverse subject areas to ensure equitable integration of artificial intelligence. The training content should be further deepened to include advanced aspects such as AI ethics and learning analytics, enabling teachers to apply AI responsibly and effectively in classroom practice.
- **For Future Community Service Practitioners/Researchers:** Follow-up studies are necessary to evaluate the impact of AI-based learning materials on student learning outcomes. Future programs may also explore cross-school collaborations and comparative studies to strengthen the evidence base for AI literacy interventions in education.

Acknowledgements

The authors would like to express their sincere gratitude to the Faculty of Computer Science and the Institute for Research and Community Service (LPPM) of Universitas Dian Nuswantoro for providing financial support through the PST Scheme (Thematic School Service Program), which enabled the successful implementation of the community service program at SMA At Thohiriyah. The authors also extend their appreciation to SMA At Thohiriyah, as a partner school of Universitas Dian Nuswantoro, for its cooperation and active participation throughout the implementation of the program.

References

- Anggraini, N., & Syamsurizal. (2025). Implementasi Pembelajaran Berdiferensiasi pada Kurikulum Merdeka Tingkat Sekolah Menengah Atas: Studi Literature Review : Penelitian. *Jurnal Pengabdian Masyarakat Dan Riset Pendidikan*, 3(4), 5892–5902. <https://doi.org/10.31004/jerkin.v3i4.1514>
- Asy'ari, M., & Sharov, S. (2024). Transforming education with ChatGPT: Advancing personalized learning, accessibility, and ethical AI integration. *International Journal of Essential Competencies in Education*, 3(2), 119–157.
- Azis, M. A., Abdullah, A., & Citra, M. Y. (2026). Meningkatkan Literasi AI di Kalangan Guru Melalui Workshop Pengenalan Prompt AI untuk Pembelajaran Inovatif di SMK Assalam Bantur, Malang. *Jurnal Flobamorata Mengabdi*, 4(1), 14–21. <https://doi.org/10.51494/jfm.v4i1.3034>
- Dana, G. W. P., Hariyanti, N. K. D., Kumara, I. M. S., Hendrawan, A., Jati, G. P. R. S., Ardiantika, R., & Athalina, G. (2026). *Generative Artificial Intelligence: Teori, Model, dan Implementasi*. Star Digital Publishing. <https://books.google.com/books?hl=id&lr=&id=M9jEEQAAQBAJ&oi=fnd&pg=PA32&dq=Pengantar+Artificial+Intelligence+Prompt+Engineering:+Dasar-Dasar+Interaksi+dengan+Model+AI+di+Sekolah&ots=bjCH9JyRAU&sig=f57EBIyuwAMgBnGUpyN3vAOsBw0>
- Diamah, A., Rahmawati, Y., Paristiowati, M., Fitriani, E., Irwanto, I., Dobson, S., & Sevilla, D. (2022). Evaluating the effectiveness of technological pedagogical content knowledge-based training program in enhancing pre-service teachers' perceptions of technological pedagogical content knowledge. *Frontiers in Education*, 7. <https://doi.org/10.3389/educ.2022.897447>
- Ding, S., & Magerko, B. (2026). Bridging Responsible AI and AI Literacy: The TEACH-RAI Framework and Toolkit for Education, Design, and Research. *Proceedings of the 57th ACM Technical Symposium on Computer Science Education V.2*, 1295–1296. <https://doi.org/10.1145/3770761.3777259>



- Ditbalnak, T. P. (2026, March 27). Keputusan Bersama Menteri Dalam Negeri, Menteri Agama, Menteri Pendidikan Dasar Dan Menengah, Menteri Pendidikan Tinggi, Sains, Dan Teknologi, Menteri Komunikasi Dan Digital, Menteri Kependudukan Dan Pembangunan Keluarga/Kepala Badan Kependudukan Dan Keluarga Berencana Nasional, Dan Menteri Pemberdayaan Perempuan Dan Perlindungan Anak Republik Indonesia Tentang Pedoman Pemanfaatan Dan Pembelajaran Teknologi Digital Dan Kecerdasan Artifisial Di Jalur Pendidikan Formal, Nonformal, Dan Informal Tahun 2026. *Orang Tua Hebat*. <https://www.orangtuahebat.id/keputusan-bersama-tentang-pedoman-pemanfaatan-dan-pembelajaran-teknologi-digital-dan-kecerdasan-artifisial-di-jalur-pendidikan-formal-nonformal-dan-informal-tahun-2026/>
- Gowda, R. V. M. (2023). Education 5.0: Evolution of Promising Digital Technologies – A Comprehensive Review. *International Journal of Advanced Science and Engineering*, 10(2), 3442–3448. <https://doi.org/10.29294/IJASE.10.2.2023.3422-3448>
- Herianto, E., Rispawati, R., Istiningsih, S., & Asrin, A. (2024). Upaya Meningkatkan Capaian Iku Perguruan Tinggi Melalui Kegiatan Sk-Mbkm Mandiri. *Jurnal Interaktif: Warta Pengabdian Pendidikan*, 4(1), 60–70.
- Hidayat, W. N., Nurlaila, N., Purnomo, E., & Aziz, N. (2023). Technological Pedagogical and Content Knowledge (TPACK) in Islamic Religious Education in the Digital Era. *Al Hikmah: Journal of Education*, 4(1), 93. <https://doi.org/10.54168/ahje.v4i1.145>
- Hidayatullah, M. S., & Shadiqi, M. A. (2020). *Diktat-Perkuliahan-Konstruksi-Alat-Ukur-Psikologi*. https://ppak.ulm.ac.id/wp-content/uploads/2020/12/Diktat-Perkuliahan-Konstruksi-Alat-Ukur-Psikologi-Ed.-Revisi-2020-fix-3.pdf?utm_source=copilot.com
- Kemdikbud, D. P. (2024). *Data Pokok SMA AT THOHIRIYYAH - Paudikdasmen* [Dataset]. <https://dapo.kemdikbud.go.id/sekolah/263EA6DC32FC3FEAED63>
- Mondal, D. (2023). Technological Pedagogical and Content Knowledge (TPACK): A Survey-Based Study on Teachers' Integration of Technology in Education. Available at SSRN 5288906. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5288906
- Muryati, M., Wicaksana, M. F., Sukarno, S., & Saptomo, S. W. (2025). Penguatan Kompetensi Asesmen Pembelajaran Bagi Guru Melalui Pelatihan Berbasis Praktik Kolaboratif. *ABSYARA: Jurnal Pengabdian Pada Masyarakat*, 6(1), 28–36. <https://doi.org/10.29408/ab.v6i1.30075>
- Muttaqin, I. (2022). Necessary to increase teacher competency in facing the artificial intelligence era. *Al-Hayat: Journal of Islamic Education*, 6(2), 549–559.
- Novita, R. (2025). AI in Lesson Planning: Improving Teacher Efficiency and Instructional Design. *JURNAL Riset RUMPUN ILMU PENDIDIKAN*, 4(2), 192–202. <https://doi.org/10.55606/jurripen.v4i2.5560>
- Nur, Q. M., & Susiawati, W. (2025). Kurikulum Merdeka: Kurikulum berorientasi masa depan. *MAURIDUNA: JOURNAL OF ISLAMIC STUDIES: STIBA Arraayah Sukabumi*, 6(1), 45–63.
- Nurfajriani, W. V., Ilhami, M. W., Mahendra, A., Afgani, M. W., & Sirodj, R. A. (2024). Triangulasi data dalam analisis data kualitatif. *Jurnal Ilmiah Wahana Pendidikan*, 10(17), 826–833.
- Qian, Y. (2025). Prompt Engineering in Education: A Systematic Review of Approaches and Educational Applications. *Journal of Educational Computing Research*, 63(7–8), 1782–1818. <https://doi.org/10.1177/07356331251365189>



- Rohmah, S. (2025). Pembelajaran Deep Learning sebagai Strategi Transformasi Pendidikan di Era Abad ke-21. *JURNAL PAUD AGAPEDIA*, 9(2), 149–156. <https://doi.org/10.17509/jpa.v9i2.92930>
- Rojabi, M. A. (2025). *Pengantar Penelitian Kuantitatif*. Afdan Rojabi Publisher. <https://books.google.com/books?hl=id&lr=&id=YfKEEQAAQBAJ&oi=fnd&pg=PA2&dq=%22penelitian+kuantitatif%22&ots=5B5vUCEE1l&sig=9oR-8EjV5ijz5qw7aTjHY2fwCJQ>
- Salih, S., Husain, O., Hamdan, M., Abdelsalam, S., Elshafie, H., & Motwakel, A. (2025). Transforming education with AI: A systematic review of ChatGPT's role in learning, academic practices, and institutional adoption. *Results in Engineering*, 25, 103837.
- Setiyani, A., Judijanto, L., Nurmawati, N., Irianto, I., Aryani, L., Fatubun, R. R., Afriyanto, D. F., Sondari, M. C., Cipta, E. S., & Merung, A. Y. (2026). *Metodologi penelitian kualitatif*. PT. Sonpedia Publishing Indonesia. <https://books.google.com/books?hl=id&lr=&id=sHDREQAAQBAJ&oi=fnd&pg=PA83&dq=penelitian+kuantitatif&ots=fH9bu3ou4S&sig=QjF8WG6t0FEoCXDbVzR5trj-XKs>
- Suwanti, N. C. (2026). *Mendikdasmen Prioritaskan Program Deep Learning untuk Tingkatkan Kualitas Pendidikan*. <https://www.kompas.tv/nasional/666566/mendikdasmen-prioritaskan-program-deep-learning-untuk-tingkatkan-kualitas-pendidikan>