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Teachers' Perceptions of the Use of Artificial Intelligence (AI) in Daily Learning at Elementary Schools

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Abstract: This research examines teachers' perceptions of the use of artificial intelligence (AI) in daily learning at elementary schools. The development of AI technology has brought significant transformation to the world of education, offering great potential to improve the quality of learning through personalized materials, automation of administrative tasks, and provision of interactive learning aids. However, the implementation of AI in elementary school learning still faces various challenges related to teachers' perceptions, competencies, and readiness. The research objectives are to analyze teachers' understanding of AI in the learning context, explore teachers' experiences in using AI-based applications, identify the benefits and challenges faced, evaluate the effectiveness of AI in supporting differentiated learning, and identify support needs for optimizing AI utilization. This research uses a qualitative approach with descriptive methods. Data were collected through in-depth interviews with six classroom teachers (grades 1-6), one school principal, and one school operator at SDN Rinjani, Cirebon City, in November-December 2024. The research instrument was a semi-structured interview guide. Data analysis used the Miles and Huberman model through stages of data reduction, data presentation, and conclusion drawing. Data validity was ensured through source triangulation and member checking. The research findings show that teachers have diverse understandings of AI, ranging from basic concepts as assistive tools to more comprehensive understanding of AI's role in learning transformation. The AI applications used include PowerPoint, Wordwall, Assemblr Edu, ChatGPT, Gemini, Perplexity, and Canva. Teachers reported various benefits of AI such as ease of access to information, efficiency in creating materials, personalized learning, and increased student creativity. The challenges faced include limited teachers' digital competence, suboptimal technological infrastructure, and the risk of excessive dependence on AI. AI was found to be effective in supporting differentiated learning through adaptation of content, process, and learning products according to individual student needs. The required support includes systematic training, infrastructure improvement, and supportive policy development. The research concludes that although teachers show positive attitudes toward AI, optimal implementation requires comprehensive investment in developing teacher competence and technological infrastructure. Further research is recommended to examine the long-term impact of AI use on student learning outcomes and develop effective teacher training models.

Keyword : Artificial intelligence, AI in education, teacher perceptions, differentiated learning, teacher digital competence.

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INTRODUCTION

The era of the Industrial Revolution 4.0 and Society 5.0 has brought fundamental transformations in various aspects of human life, including the education sector. Artificial Intelligence (AI) as one of the major disruptive technologies has transformed the global education landscape by offering great potential to improve the quality, accessibility, and effectiveness of learning (Holmes et al., 2019). According to a UNESCO report (2021), AI has the ability to personalize learning, automate administrative tasks, identify learning gaps, and provide adaptive learning support according to each student's individual needs.

In the context of Indonesian education, the Ministry of Education, Culture, Research, and Technology has launched various initiatives to integrate digital technology, including AI, in learning through the Merdeka Learning program and the digital transformation of education. Platforms such as Merdeka Mengajar, various adaptive learning applications, and AI-based tools have begun to be introduced to schools in Indonesia. However, the successful implementation of AI technology in learning is highly dependent on the perception, attitude, and readiness of teachers as the spearhead of implementing learning in the classroom (Crompton & Burke, 2023).

Teachers have a central role in determining the success of AI integration in learning. Research shows that teachers' positive perceptions of technology are a strong predictor of the adoption and effective implementation of technology in learning practices (Scherer et al., 2019). Teachers' perceptions are influenced by a variety of factors, including understanding of technology, experience of use, perceived usefulness and perceived ease of use, and available infrastructure and training support (Venkatesh & Davis, 2000).

Although the potential of AI in education is very promising, its implementation in elementary schools in Indonesia still faces various challenges. Research by Chounta et al. (2022) identified several key challenges, namely: (1) the gap in teachers' digital competencies in understanding and using AI; (2) limited technological infrastructure in schools, especially in the regions; (3) concerns about the ethical implications of the use of AI in early childhood learning; (4) the lack of practical models and guidelines for effective integration of AI in learning; (5) the limitations of empirical research on the impact of AI on the learning outcomes of elementary school students.

The research gap arises when examining the specific context of Indonesia, especially at the elementary school level. The majority of research on AI in education focuses on higher education or secondary schools in developed countries, while research on the perceptions and practices of elementary school teachers in Indonesia in using AI is still very limited (Wibowo et al., 2023). Furthermore, although some studies have identified common challenges in the implementation of educational technology, a deep understanding of how primary school teachers in Indonesia

perceive, use, and experience AI in the context of their daily learning is still not comprehensively studied.

Several previous studies have examined the adoption and implementation of AI in educational contexts from various perspectives. Holmes et al. (2019) in their comprehensive study of AI in education identified three main categories of AI applications: (1) AI for learning which includes intelligent tutor systems, adaptive learning, and pedagogical agents; (2) AI about learning which includes learning analytics and educational data mining; (3) AI to prepare for AI that focuses on AI literacy for students and teachers. Zawacki-Richter et al. (2019) conducted a systematic review of 146 articles on AI in higher education and identified four main areas of application: (1) profiling and prediction to identify students at risk of dropout; (2) intelligent tutoring systems for personalized learning; (3) automatic assessment and evaluation; (4) Adaptive Systems and Personalization in Learning. However, the study also found that most of the research was exploratory and still lacked focus on the impact of pedagogy and student learning outcomes. In the context of teacher perception, Scherer et al. (2019) examined the factors that influence the adoption of technology by teachers using the Technology Acceptance Model (TAM). They found that perceived usefulness and perceived ease of use were strong predictors of the actual intentions and behaviors of technology use. Teachers' self-efficacy in using technology also plays an important role as a mediator between the characteristics of technology and actual adoption. Crompton and Burke (2023) examined the use of generative AI (such as ChatGPT) in education and found that teachers have ambivalent perceptions. On the one hand, they recognize the potential of AI to help differentiated learning, provide instant feedback, and reduce administrative workload. On the other hand, they are concerned about ethical implications, the risk of plagiarism, and the potential to reduce students' critical thinking. In the Indonesian context, Wibowo et al. (2023) examined teachers' readiness to implement digital technology-based learning and found that although the majority of teachers have a positive attitude towards technology, their level of digital competence still varies. Factors such as age, teaching experience, access to training, and school support affect teacher readiness levels. Chounta et al. (2022) examined the challenges of implementing AI in primary education and found that in addition to technical challenges, there are significant pedagogical challenges. Teachers need to understand not only how to use AI tools, but also how to integrate them effectively in their pedagogical practices and how to guide students to use AI critically and ethically.

This research has several novelties that distinguish it from previous research. First, this study specifically examines the perceptions and experiences of elementary school teachers in Indonesia in using AI for daily learning, not just technology adoption in general. The context of elementary schools in Indonesia has unique

characteristics that are different from international research settings in higher or secondary education.

Second, the study integrates multistakeholder perspectives (classroom teachers of different levels, principals, and school operators) to provide a holistic picture of AI implementation at the school level. Third, this study not only identifies perceptions and challenges, but also explores the concrete practices of using AI by teachers, including the types of applications used, integration strategies in learning, and the impact felt on students.

Fourth, this study specifically examines the role of AI in supporting differentiation of learning, an aspect that is very relevant to the context of the Independent Curriculum in Indonesia which emphasizes differentiated learning. Fifth, this research was conducted on schools that already have adequate technology infrastructure (Chromebooks, Interactive Flat Panels, belajar.id accounts) but are still in the early stages of AI implementation, providing insights into the transition phase from the use of conventional technology to AI-powered learning.

The urgency of this research is driven by several crucial factors. First, accelerating the adoption of AI in education post-COVID-19 pandemic demands an in-depth understanding of how teachers perceive and implement this technology. The pandemic has accelerated the digital transformation of education, and AI has become one of the key technologies in supporting the new normal of learning.

Second, the Independent Curriculum policy that emphasizes differentiated learning requires technological support that can accommodate the diversity of needs, learning styles, and learning speeds of students. AI has great potential in supporting the implementation of differentiated learning, but teachers' understanding of how to leverage AI for this purpose still needs to be further studied.

Third, significant government investment in educational technology infrastructure needs to be evaluated for effectiveness. Without a good understanding of teachers' perceptions, competencies, and needs, investments in technology may not produce optimal impact on the quality of learning. Fourth, the rapid development of generative AI such as ChatGPT, Gemini, and various other AI tools requires clear guidance and frameworks for teachers on how to use these technologies ethically, effectively, and safely.

Based on the background and research gaps that have been presented, this study aims to:

1. Analyze elementary school teachers' understanding of the concept and role of AI in the context of learning.
2. Explore teachers' experiences in using AI-based applications and tools in teaching activities, including the types of applications used and how they are used.
3. Identify the benefits, conveniences, challenges, and impacts that teachers and students feel from the use of AI in learning.

4. Evaluate teachers' perceptions of the effectiveness of AI in supporting learning differentiation and learning personalization.
5. Identify the support needs (training, infrastructure, policies) that teachers need to optimize the use of AI in learning.

METHODOLOGY

Approaches and Types of Research

This research uses a qualitative approach with descriptive analysis. The qualitative approach was chosen because this study aims to deeply understand the phenomenon of teachers' perceptions and experiences in using AI, which is a complex and contextual phenomenon that is difficult to quantitatively measure (Creswell & Poth, 2018).

This type of phenomenological descriptive research allows researchers to explore and describe the meaning that teachers give to their experiences with AI in the context of daily learning. The phenomenological approach emphasizes the understanding of the "lived experience" of the research subject, in this case the teacher's experience in adopting and using AI (Moustakas, 1994).

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Research Location and Time

This research was conducted at SDN Rinjani Cirebon City, West Java Province, Indonesia. The selection of the location was based on several strategic considerations. First, SDN Rinjani is a school that has integrated technology in learning with adequate infrastructure, including Chromebooks for grades 4-6, Interactive Flat Panel (IFP), active belajar.id accounts for students and teachers, and a stable internet network. Second, the school has a digital transformation program and some teachers have started exploring the use of AI in learning.

Third, the principal and teachers showed openness and willingness to participate in this research. Fourth, the context of this school is representative of urban

schools in Indonesia that are in the transition from the use of conventional technology to AI-based technology. The research was carried out for two months, namely in the November-December 2024 period, coinciding with the implementation of odd semesters where teachers have had sufficient experience in implementing various learning approaches, including the use of technology.

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Data Source

The data sources in this study are divided into two categories:

1. Primary Data Sources

Primary data sources were obtained directly from informants through in-depth interviews. Informants were selected using purposive sampling with the following criteria: (1) active classroom teachers who teach at SDN Rinjani; (2) have at least one year of teaching experience; (3) have or are exploring the use of digital technology/AI in learning; (4) willing to participate in research.

The total number of informants was 8 people consisting of: (1) Six classroom teachers, each representing grades 1, 2, 3, 4, 5, and 6, to gain perspectives from different grade levels; (2) One principal who plays the role of a policy maker and has a strategic view on the implementation of technology in schools; (3) One school operator who is responsible for the technological infrastructure and provides technical support to teachers.

2. Secondary Data Sources

Secondary data sources were obtained from school documentation and literature studies. School documentation includes school profiles, technology

infrastructure data, technology use policies, documentation of technology-based learning activities, and records of teachers' learning communities (kombel). Literature studies include international and national journals on AI in education, books on educational technology, UNESCO and OECD policy reports on AI in education, and the Ministry of Education and Culture's policy document on the digital transformation of education.

Data Collection Techniques and Instruments

The main data collection technique is semi-structured in-depth interviews. Semi-structured interviews are chosen because they provide the flexibility to explore topics in depth while still ensuring that all important topics are covered (Kvale & Brinkmann, 2009).

The research instrument is in the form of interview guidelines developed based on the research objectives and the theoretical framework of the Technology Acceptance Model (TAM) and the TPACK framework. The interview guidelines grid for teachers include: (1) Understanding of AI in learning: AI concepts, the role of AI, the differences between AI and conventional technologies; (2) Experience of using AI: application/tools used, frequency of use, context of use, way of integration in learning; (3) Perception of benefits and convenience: perceived usefulness, perceived ease of use, impact on learning efficiency and effectiveness; (4) Challenges and constraints: digital competencies, infrastructure, support, ethical concerns; (5) The effectiveness of AI in learning differentiation: adaptation of content, processes, products; personalization of learning; (6) Support needs: training, infrastructure, policies, resources.

For principals and operators, the grids include: (1) The school's views and policies on AI; (2) School support for AI implementation; (3) Available infrastructure and resources; (4) Implementation constraints and solutions implemented; (5) Future development plans. All interviews were recorded audio with the informant's permission and transcribed verbatim for analysis.

Data Analysis Techniques

Data analysis uses the model of Miles and Huberman (1994) which consists of three flows of activities that take place simultaneously: data reduction, data presentation, and conclusion/verification.

1. Data Reduction

Data reduction begins with a verbatim transcript of all interview recordings. The researcher then conducts open coding to identify units of meaning that are relevant to the research objective. Open codes are then grouped into broader categories through axial coding. The coding process is done iteratively by re-reading the transcript several times to ensure no important information is missed.

2. Data Presentation

The reduced data is presented in the form of structured narrative texts, matrices, and diagrams. Verbatim excerpts from interviews are used to provide concrete illustrations and maintain the voice of the informant. The presentation of data is organized around the main themes that emerge from the analysis, facilitating a holistic understanding of the phenomenon being studied.

3. Conclusion Drawing and Verification

Initial conclusions are drawn tentatively and continue to be verified throughout the research process. Verification is carried out through member checking, source triangulation, and search for negative cases that may not match the pattern that has been identified. The final conclusion is drawn after all the data has been analyzed and verified.

Data Validity Test

The validity and reliability of the data are guaranteed through several strategies. First, source triangulation is carried out by collecting data from various informants (teachers from various grade levels, principals, operators). Second, member checking is carried out by returning transcripts and provisional findings to the informant for verification. Third, peer debriefing is carried out by discussing findings with other researchers or education technology experts.

Fourth, trail audits are maintained by documenting the entire research process in detail. Fifth, thick descriptions are used in reporting to provide rich context and allow readers to assess the transferability of findings. Sixth, reflexivity is maintained where the researcher critically reflects on his position, bias, and influence on the research.

RESULT AND DISCUSSION

Research Results

The results of the study were presented based on the analysis of interview data with 8 informants. The findings are organized according to the research objectives and presented by maintaining the informant's verbatim statements.

1. Teachers' Understanding of AI in Learning

Data analysis shows that teachers have varying levels of understanding of AI in the context of learning, ranging from basic understanding to more comprehensive understanding.

a. Basic Level Understanding: AI as a Technology Tool

Grade 1 teachers understand AI as:

> "*Penerapan teknologi kecerdasan buatan untuk mendukung proses belajar mengajar dengan cara mempersinalisasi materi, mengotomatiskan tugas administratif, dan menyediakan alat bantu belajar yang interaktif bagi siswa dan guru.*" *Pemahaman ini*

menunjukkan konsep yang cukup komprehensif meskipun masih bersifat teoritis" (Grade 1 Teacher, 2025).

The 2nd grade teacher showed a simpler understanding:

"*Pemahaman AI tentang pemeblajaran, semacam Powerpoint Word pokoknya berbasis teknologi dalam pembelajaran pendahuluan inti dan penilaian siswa." Pernyataan ini menunjukkan bahwa guru masih mengasosiasikan AI dengan aplikasi teknologi umum seperti PowerPoint"* (Grade 2 Teacher, 2025).

The 4th grade teacher gave a practical definition:

"*AI itu alat bantu guru yang bisa memberi materi, menyiapkan soal secara cepat." Pemahaman ini menekankan aspek efisiensi dan fungsi praktis AI dalam mengurangi beban kerja guru"* (Grade 4 Teacher, 2025).

b. Intermediate Level Comprehension: AI as an Effective Learning Support

Grade 3 teachers have a more critical understanding:

"*Menurut saya penggunaan AI dalam kegiatan pembelajaran sangat efektif jika pemanfaatan AI digunakan sesuai kebutuhan kegiatan pembalaran." Pernyataan ini menunjukkan pemahaman tentang pentingnya alignment antara penggunaan AI dengan tujuan pembelajaran* (Grade 3 Teacher, 2025).

c. Advanced Level Comprehension: AI as a Learning Transformation

Grade 5 teachers demonstrate the most comprehensive understanding:

"*Penggunaan AI dalam pembelajaran bagi saya adalah sebagai alat bantu untuk meningkatkan efisiensi dan inklusifitas pengalaman belajar murid. AI membantu mengefisiensikan kerja guru, tapi bukan sebagai pengganti guru tetapi sebagai sumber ilmu. Peran guru dibantu oleh AI, bukan peran guru dapat diganti oleh AI." Pemahaman ini menunjukkan kesadaran tentang peran AI yang complementary, bukan substitutef* (Grade 5 Teacher, 2025).

The 6th grade teacher gave a philosophical view:

"*Kita bisa memanfaatkan teknologi, tetapi jangan dalam pembelajaran dipengaruhi oleh teknologi. Jadi, kita bisa memanfaatkan teknologi, tetapi jangan lupa kita harus mengikuti perkembangan zaman, tetapi kita jangan di perbudak, karena AI ini secara kodratnya teknologi sebagai sumber belajar." Perspektif ini menekankan pentingnya menjaga otonomi pedagogis guru* (Grade 6 Teacher, 2025).

2. AI-Based Application Experience

Teachers report using a variety of AI or digital-based apps and tools in their learning.

a. Applications Used

Grade 1 teachers use: "Wordwall" to create interactive learning activities. Grades 2 and 4 teachers use: "PowerPoint" as a presentation tool. The 3rd grade teacher reported: "Ever. Assemblr Edu" which is an Augmented Reality (AR) and Virtual Reality (VR) based learning platform.

Grade 5 teachers have a broader experience:

> "*Tentu pernah, terlebih yang dasar (basic). Saya sebagai guru transformator digital tentu menggunakan aplikasi atau alat berbasis AI yang dapat saya gunakan sebagai alat bantu mengajar atau juga sebagai media dan alat untuk pembelajaran agar anak-anak juga memiliki kecakapan dasar untuk menggunakan AI yang sederhana seperti Chat GPT, Gemini, Canva* (Grade 5 Teacher, 2025)."

Grade 6 teachers reported:

> "*Pernah. Saya menggunakan Chat GPT, Perplexity, Gemini, karena aplikasi itu semua mempermudah guru mencari sumber belajar dan memodifikasi lagi* (Grade 6 Teacher, 2025)."

It demonstrates the use of generative AI for learning preparation.

3. Benefits, Ease, and Challenges of Using AI

a. Benefits and Facilities

Grade 1 teachers reported: "*Memudahkan dalam proses pembelajaran dan dapat menarik minat belajar siswa*" serta "*Cukup efektif dan memudahkan (*Grade 1 Teacher, 2025)." The 2nd grade teacher mentioned*:* "*Dapat informasi lebih cepat*" *dan* "*Dengan cara membuat konten saat pembelajaran* (Grade 2 Teacher, 2025)."

The 3rd grade teacher gave a more detailed testimonial:

> "*Pengalaman saya adalah penggunaan AI sangat membantu pemahaman siswa terhadap materi yang disampaikan serta mencapai tujuan pelajaran yang diharapkan. Dampak yang terlihat pada siswa adalah siswa lebih tertarik dalam kegiatan pembelajaran* (Grade 3 Teacher, 2025)."

Grade 4 teachers reported:

> "*Lumayan membantu, karena cepat dan praktis*" *dan* "*Cukup efektif karena AI bisa bantu menyesuaikan materi sesuai kemampuan anak* (Grade 4 Teacher, 2025)."

The 5th grade teacher provides a comprehensive analysis of the facility:

"*Pengalaman saya menggunakan AI cukup membantu dan mudah diterapkan di sekolah. Hal ini dikarenakan sarana dan prasarana yang sudah tersedia di sekolah seperti jaringan internet, laptop, chromebook, akun belajar.id murid dan sudah aktif, Interactive Flat Panel (IFP), dll.*" Guru ini juga melaporkan dampak positif: "*Dampaknya, saya pernah mengajarkan peserta didik membuat buku cerita sederhana dengan bantuan AI dan Canva. Anak-anak antusias dan jadi lebih kreatif. Orang tua juga bangga dengan hasil karya anak-anak* (Grade 5 Teacher, 2025)."

The 6th grade teacher mentioned:

"*Kemudahannya, pasti dimudahkan karena ada teknologi untuk mencari sumber, media, materi pembelajaran*" dan "*Dampak positif bagi siswa anak lebih mudah mencari. Jadi kita memodifikasi lagi* (Grade 6 Teacher, 2025)."

b. Challenges and Difficulties

Grade 2 teachers identified the main challenges:

"*Tantanganya dari zaman sekarang guru yang kurang paham dengan AI itu tantangannya*" dan "*Dari gurunya harus mempersiapkan* (Grade 2 Teacher, 2025)."

Grade 3 teachers reported:

"*Kesulitannya adalah banyaknya siswa di kelas rendah yang belum sepenuhnya mempunyai gadget sendiri.*" *Ini menunjukkan tantangan ekuitas akses teknologi"* (Grade 3 Teacher, 2025).

Grade 5 teachers identified infrastructure challenges:

"*Tantangan: Tentu ada, misalnya kurangnya fasilitas mini Lab TIK yang belum aktif di sekolah, jadi sarana dan prasarana masih harus mobile ke kelas* (Grade 5 Teacher, 2025)."

Grade 6 teacher highlights the limitations of AI:

"*Kelemahan AI kadang jawabannya kurang sesuai.*" *Ini menunjukkan kesadaran kritis tentang limitasi teknologi AI"* (Grade 6 Teacher, 2025).

The principal gave a balanced view:

"*Sangat bermanfaat dan membantu guru-guru dalam membuat soal, modul ajar, dan sebagainya. Tetapi ada kelemahannya juga, guru tidak mau berpikir dan juga*

mengembangkan" serta "PROnya sangat membantu sedangkan kontranya guru tidak mau mengembangkan lagi (Principal, 2025)."

It identifies the risk of over-reliance on AI.

4. The Effectiveness of AI in Learning Differentiation

Teachers report that AI is effective in supporting differentiation of learning. The 1st grade teacher stated:

"*Sumber daya yang membantu penerapan AI, dan bagaimana AI itu sendiri dapat mendukung berbagai fungsi dan tugas* (Grade 1 Teacher, 2025)."

The 3rd grade teacher explained:

"*Dalam menyesuaikan dengan gaya belajar siswa, dapat dengan cepat dan mudah menganalisis kemampuan siswa* (Grade 3 Teacher, 2025)."

This statement demonstrates an understanding of AI's capabilities in learning assessment and adaptation. Grade 4 teachers reported:

"*Cukup efektif karena AI bisa bantu menyesuaikan materi sesuai kemampuan anak* (Grade 4 Teacher, 2025)."

This indicates the use of AI for content personalization. The 5th grade teacher provides the most comprehensive analysis:

"*Sangat efektif dalam berbagai hal, misalnya untuk kegiatan administrasi guru, konten pembelajaran juga bisa lebih bervariasi. Membantu dalam meningkatkan keterlibatan siswa. Anak-anak terlibat aktif dalam pembelajaran. Pembelajaran juga jadi terdiferensiasi konten, proses, dan produk. Membantu saya sebagai guru untuk menciptakan pembelajaran yang bermakna dan menyenangkan* (Grade 5 Teacher, 2025)."

This statement demonstrates a deep understanding of content, process, and product differentiation. The 6th grade teacher stated:

"*AI sangat membantu, mempermudah, dan kita harus menyesuaikan dengan peserta didik* (Grade 6 Teacher, 2025)."

5. Support Needs for AI Optimization

Teachers identify various support needs to be able to make optimal use of AI.

a. Training and Competency Development

The 4th grade teacher stated: "*Harus ada pelatihan untuk cara pakai AI* (Grade 4 Teacher 2025)." Grade 6 teacher emphasizes*: "Pelatihan bagi bapak dan ibu guru, tidak semua orang paham tentang AI* (Grade 6 Teacher 2025)."

Grade 3 teachers provide a more specific list:

"*a. Peningkatan Kompetensi Guru dalam penggunaan AI; b. Sarana dan prasana yang mendukung kegiatan pembelajaran dengan penggunaan AI; c. Koordinasi antara guru, orangtua dan siswa itu sendiri dalam pemanfaatn penggunaan AI dalam pembelajaran* (Grade 3 Teacher, 2025)."

b. Infrastructure and Resources

The 5th grade teacher provides a very detailed list of needs:

"*Sarana dan prasarana yang optimal untuk mendukung pembelajaran berbasis digital, seperti: Tambahan chromebook atau laptop untuk anak-anak; IFP di tiap-tiap kelas; Kuota internet yang stabil dan optimal; Pelatihan digitalisasi bagi guru-guru; Ketersediaan sumber belajar yang baik untuk pembelajaran dengan menggunakan AI* (Grade 5 Teacher, 2025)."

c. Policy and Management Support

The Principal stated:

"*Kita sangat mendukung apabila AI itu bermanfaat" dan menjelaskan kebijakan yang sudah diterapkan: "Penggunaan AI digunakan pada saat komunitas belajar (Kombel)* (Principal, 2025)."

This shows that the school has integrated learning about AI in teacher professional development programs.

The principal also reported the benefits to teachers and students:

"*Bagi Guru: Sangat membantu, apalagi guru di sini beberapa belum bisa IT. Dengan adanya AI bisa saling membantu. Bagi Anak-anak: Sudah diajarkan mengenai AI. Anak kelas 5 diberi tugas membuat buku cerita menggunakan AI* (Principal, 2025)."

Discussion

The findings of this study provide important insights into teachers' perceptions and experiences in adopting and implementing AI in learning. The discussion was organized based on the main themes that emerged from the data and was associated with previous theories and research.

1. The Spectrum of Teacher Understanding of AI: From Tool Technology to Pedagogical Transformation

The findings show that there is a spectrum of teachers' understanding of AI, ranging from a basic understanding as a technological tool to a more sophisticated understanding of the transformative potential of AI in learning. This variation of understanding is in line with the Technological Pedagogical Content Knowledge (TPACK) model developed by Mishra and Koehler (2006), where effective technology integration requires not only technological knowledge, but also an understanding of how technology interacts with pedagogical knowledge and content.

Teachers with a basic level understanding tend to see AI as a tool for administrative efficiency, in line with the findings of Zawacki-Richter et al. (2019) that many early implementations of AI in education focused on automating routine tasks. However, teachers with advanced level understanding show awareness of AI's potential to transform learning, in line with Holmes et al.'s (2019) vision of "AI for learning" that emphasizes personalization and adaptation of learning.

The 5th grade teacher's statement emphasizing that "AI helps streamline teachers' work, but not as a substitute for teachers" reflects a mature understanding of the complementary role of AI in education. This is in line with the concept of "human-centered AI" developed by UNESCO (2021), where AI is designed to augment human capabilities, not replace them. The 6th grade teacher's philosophical perspective on "not enslaved to technology" is also important, echoing concerns about technological determinism in education (Selwyn, 2016).

AI Adoption and Use: From Conventional Tools to Generative AI

The findings show that teachers use a wide spectrum of applications, from conventional tools like PowerPoint to generative AI like ChatGPT and Gemini. This adoption pattern reflects the technology adoption lifecycle where early adopters (such as teachers in grades 5 and 6) explore cutting-edge technology, while the early majority still use more established technologies (Rogers, 2003).

The use of Wordwall and Assemblr Edu shows the teacher's awareness of the importance of engagement and interactivity in learning, in line with the principles of constructivist learning (Piaget, 1970). The use of generative AI such as ChatGPT for learning preparation shows that teachers are beginning to explore the potential of AI for content creation and instructional design, in line with the findings of Crompton and Burke (2023) on emerging uses of generative AI in education.

The case of a 5th grade teacher teaching students to create storybooks with AI and Canva is very interesting, showing the use of AI not only for teachers but also to equip students with AI literacy. This is in line with the recommendations of Long and Magerko (2020) about the importance of teaching AI literacy from an early age, not

only how to use AI, but also understanding how AI works, its capabilities and limitations, and ethical considerations.

Perceived Benefits dan Technology Acceptance

Teacher-reported benefits include efficiency, effectiveness, student engagement, and personalization of learning. These findings support the Technology Acceptance Model (TAM) of Venkatesh and Davis (2000), where perceived usefulness is a strong predictor of technology adoption. Teachers who see the concrete benefits of AI in reducing workload, improving the quality of learning, and supporting differentiation are more likely to adopt and use AI consistently.

Perceived ease of use is also an important factor. Teachers who reported that AI was "fast", "practical", and "easy to apply" showed a high perceived ease of use. However, teachers who reported challenges in understanding and using AI showed low perceived ease of use, which can be a barrier to adoption (Scherer et al., 2019).

The positive impact on students that teachers report – enthusiasm, creativity, active participation – is in line with research on the impact of interactive technology on motivation and engagement (Ryan & Deci, 2000). The involvement of parents who are proud of their children's work is also important, showing that AI can be a bridge between home and school learning.

Implementation Challenges: Competencies, Infrastructure, and Pedagogical Concerns

The challenges identified include three main dimensions: teacher competence, technological infrastructure, and pedagogical concerns. The gap in teachers' digital competencies is in line with the findings of Wibowo et al. (2023) on the variation in digital readiness of teachers in Indonesia. The need for consistent training is identified by almost all teachers, indicating that professional development in AI is an urgent priority.

Infrastructure challenges - limitations of devices, connectivity, and ICT labs - reflect the digital divide that still exists in Indonesia (Luschei & Chudgar, 2011). Although SDN Rinjani already has a relatively good infrastructure, there are still gaps such as not all students have their own devices and the ICT lab is not yet active. This shows that equitable access to AI technology is still a challenge.

The pedagogical concerns raised by the principal about "teachers do not want to think and develop" are very important. This echoes concerns about deskilling teachers if they rely too much on AI (Selwyn, 2019). The weakness of AI that "sometimes the answer is not appropriate" mentioned by grade 6 teachers is also important, showing critical awareness about the limitations and potential biases of AI (UNESCO, 2021).

AI for Learning Differentiation: From Theory to Practice

The finding that AI is effective in supporting differentiation of learning is very significant in the context of the Independent Curriculum in Indonesia which emphasizes differentiated learning. Teachers report that AI helps in the differentiation of content (variation of materials), processes (adaptation of learning methods), and products (variation of learning outcomes), in line with the differentiation framework of Tomlinson (2001).

AI's ability to "quickly and easily analyze students' abilities" and "adjust materials according to children's abilities" shows the potential of AI in learning analytics and adaptive learning. This is in line with intelligent tutoring systems that can provide personalized feedback and adapt instruction based on student performance (VanLehn, 2011).

However, it is important to note that effective differentiation requires not only AI tools, but also pedagogical expertise of teachers in designing and implementing differentiated instruction. AI is an enabler, not a panacea. Teacher agency and pedagogical decision-making remain central (UNESCO, 2021).

Support Ecosystem for Sustainable AI Implementation

The support needs identified by teachers include multiple levels: individual (training and competency development), institutional (infrastructure and policy), and systemic (coordination between stakeholders). This is in line with the ecological perspective on technology integration which sees the implementation of technology as a phenomenon influenced by multiple interacting systems (Bronfenbrenner, 1979).

The role of school principals in supporting the implementation of AI through policies such as AI learning in the learning community (kombel) shows the importance of leadership support. A distributed leadership model where digital transformer teachers share expertise with other teachers is also important for sustainable implementation (Spillane, 2006).

The need for teacher-parent-student coordination mentioned by grade 3 teachers reflects the importance of home-school partnership in the digital era. Parents need to understand and support the use of AI so that positive reinforcement occurs at home and school (Epstein, 2018).

CONCLUSION

Conclusion

Based on the results of the research and discussion, several main conclusions can be drawn:

First, elementary school teachers have a diverse understanding of AI in learning, ranging from a basic understanding as a tool for efficiency to a more

sophisticated understanding of AI's transformative potential. This variation in understanding is influenced by exposure to technology, user experience, and access to training. Teachers with more advanced understanding tend to see AI as complementary tools that augment teacher capabilities, not replace them.

Second, teachers have used a variety of AI-based applications and tools, ranging from conventional tools such as PowerPoint to generative AI such as ChatGPT, Gemini, and Perplexity. Interactive learning apps such as Wordwall and Assemblr Edu are also used to increase student engagement. Early adopters are already exploring how to integrate AI not only for teacher learning preparation, but also for student learning activities, such as the project to create storybooks using AI.

Third, teachers reported a range of significant benefits from using AI, including: efficiency in learning preparation and administrative tasks; ease of access to information and learning resources; variety and quality of learning content; Personalize learning according to the needs of students; increased student engagement, enthusiasm, and creativity; and support for differentiated learning. However, challenges were also identified, including the digital competency gap of teachers, the limitations of technology infrastructure, the risk of over-reliance on AI, and the limitations of AI in providing always accurate and appropriate answers.

Fourth, AI is considered effective in supporting learning differentiation through its ability to analyze student abilities, adapt learning content, provide variety in the learning process, and support a variety of learning products. However, this effectiveness depends on the pedagogical expertise of teachers in designing and implementing differentiated learning with the support of AI.

Fifth, the optimal implementation of AI in learning requires comprehensive support that includes: systematic and ongoing training to improve teachers' digital competence and AI literacy; improved technology infrastructure including devices, connectivity, and ICT labs; development of supportive school policies; coordination between teachers, parents, and students; as well as the availability of learning resources and best practices for learning with AI. Leadership support from school principals and distributed leadership models are also important for sustainable implementation.

Research Limitations

This research has several limitations. First, the research was conducted in one school with a relatively good technological infrastructure, so the findings may not be fully transferable to schools with different contexts, especially schools in areas with limited infrastructure.

Second, the number of informants is limited (8 people) and does not include the perspective of students and parents directly. Future research can engage students and parents to gain a more comprehensive perspective. Third, this study is cross-

sectional and does not examine changes in perceptions and practices of overtime teachers. Longitudinal studies are needed to understand the adoption trajectory and long-term impact.

Fourth, this study focuses on teachers' perceptions and reported experiences, without direct observation of the implementation of AI in the classroom or objective assessment of the impact of AI on student learning outcomes. Future research can use a mixed-methods approach with class observation and pre-post assessment.

Recommendations

First, longitudinal research to examine the trajectory of AI adoption by teachers and the long-term impact on teaching practices and student learning outcomes. Second, mixed-methods research with classroom observation and objective assessment to examine the actual implementation and impact of AI in learning. Third, comparative research between schools with different levels of infrastructure and support to understand the contextual factors that affect successful implementation.

Fourth, research on the development and evaluation of the effectiveness of teacher training models in AI that are contextually appropriate for Indonesia. Fifth, research on the perspectives of students and parents on the use of AI in learning. Sixth, research on ethical and equity issues in the implementation of AI in elementary schools.

First, the development of AI literacy training programs for teachers that are comprehensive, practical, and ongoing. Training must cover not only technical skills but also pedagogical integration, critical evaluation of AI tools, and ethical considerations. The training model can use a cascading approach where digital transformer teachers become mentors to other teachers.

Second, increased investment in equitable technology infrastructure, ensuring all students have access to adequate devices and connectivity. Third, the development of clear school policies on the use of AI, including guidelines on appropriate use, data privacy, and ethical considerations.

Fourth, the development of a repository of best practices and lesson plans for learning with AI that can be accessed and adapted by teachers. Fifth, strengthening home-school partnerships through parental education about AI in learning and how to support children at home. Sixth, the development of communities of practice where teachers can share experiences, challenges, and solutions in implementing AI.

REFERENCES

Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design. Cambridge, MA: Harvard University Press.

Chounta, I. A., Bardone, E., Raudsep, A., & Pedaste, M. (2022). Exploring teachers' perceptions of artificial intelligence as a tool to support their practice in

Estonian K-12 education. International Journal of Artificial Intelligence in Education, 32(3), 725-755.

Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Thousand Oaks, CA: SAGE Publications.

Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. International Journal of Educational Technology in Higher Education, 20(1), 22.

Epstein, J. L. (2018). School, family, and community partnerships: Preparing educators and improving schools (2nd ed.). New York: Routledge.

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Boston, MA: Center for Curriculum Redesign.

Kvale, S., & Brinkmann, S. (2009). InterViews: Learning the craft of qualitative research interviewing (2nd ed.). Los Angeles: SAGE Publications.

Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, 1-16.

Luschei, T. F., & Chudgar, A. (2011). Teachers, student achievement and national income: A cross-national examination of relationships and interactions. Prospects, 41(4), 507-533.

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook (2nd ed.). Thousand Oaks, CA: SAGE Publications.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017-1054.

Moustakas, C. (1994). Phenomenological research methods. Thousand Oaks, CA: SAGE Publications.

Piaget, J. (1970). Science of education and the psychology of the child. New York: Orion Press.

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68-78.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. Computers & Education, 128, 13-35.

Selwyn, N. (2016). Is technology good for education? Cambridge: Polity Press.

Selwyn, N. (2019). Should robots replace teachers? AI and the future of education. Cambridge: Polity Press.

Spillane, J. P. (2006). Distributed leadership. San Francisco: Jossey-Bass.

Tomlinson, C. A. (2001). How to differentiate instruction in mixed-ability classrooms (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

UNESCO (2021). AI and education: Guidance for policy-makers. Paris: UNESCO Publishing.

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. Educational Psychologist, 46(4), 197-221.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46(2), 186-204.

Wibowo, S., Grandhi, S., Chugh, R., & Sawir, E. (2023). The impact of artificial intelligence (AI) on teachers' professional competencies in higher education. Journal of Higher Education Policy and Management, 45(1), 71-86.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education: Where are the educators? International Journal of Educational Technology in Higher Education, 16(1), 39.

Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. In J. A. Larusson & B. White (Eds.), Learning analytics: From research to practice (pp. 61-75). New York: Springer.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. IEEE Access, 8, 75264-75278.

Goksel, N., & Bozkurt, A. (2019). Artificial intelligence in education: Current insights and future perspectives. In S. Sisman-Ugur & G. Kurubacak (Eds.), Handbook of research on learning in the age of transhumanism (pp. 224-236). Hershey, PA: IGI Global.

Hwang, G. J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of artificial intelligence in education. Computers and Education: Artificial Intelligence, 1, 100001.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence unleashed: An argument for AI in education. London: Pearson Education.

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development. Paris: UNESCO.

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. International Journal of Artificial Intelligence in Education, 26(2), 582-599.

Timms, M. J. (2016). Letting artificial intelligence in education out of the box: Educational cobots and smart classrooms. International Journal of Artificial Intelligence in Education, 26(2), 701-712.