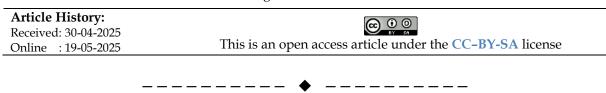# Integration of Generative Artificial Intelligence in Madrasah Ibtidaiyah Teacher Education: Opportunities and Challenges

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Abstract: This study aims to explore the opportunities and challenges of integrating generative artificial intelligence (GenAI) in elementary school (MI) teacher education through a library research or integrative review approach. By analyzing scientific literature from 2015–2024 obtained from various reputable academic databases, this study identifies GenAI's contribution to improving learning effectiveness, teacher work efficiency, and innovation in MI education practices. The results of the analysis indicate that the use of GenAI, such as ChatGPT and Bard, has great potential to support the development of automatic lesson plans, HOTS-based assessments, and the creation of contextual Islamic teaching materials. However, this integration still faces challenges in the form of limited digital literacy of teachers, uneven infrastructure, and concerns about ethics, plagiarism, and content that conflicts with Islamic values. Character education that has been embedded in the MI curriculum is an important foundation in forming ethical and meaningful use of GenAI. This study recommends ongoing training, strategic policies, and multi-party collaboration to ensure the readiness of MI teachers in facing AI-based digital transformation.

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A. INTRODUCTION

Generative Artificial Intelligence (GENAI) denotes a set of technologies that are adept at creating new content, including text, images, or code, based on previously acquired data. In the field of education, GenAI has the capacity to change the learning paradigm by facilitating personalized and adaptive educational experiences. According to Noroozi et al. (2024), GenAI has the potential to improve educational outcomes through customized feedback and to support language acquisition and research efforts. Furthermore, Huang et al. (2024) underline that the integration of GenAI in pre-service teacher education can improve the digital literacy and critical thinking competencies of future educators

Research conducted by Huang et al. (2024) showed that the substantive application of Generative Artificial Intelligence (GenAI) in educational technology curricula has the potential to improve the digital literacy of pre-service educators, especially in the domains of information processing and problem-solving ability. An investigation conducted by Kildė (2024) also revealed that the incorporation of GenAI into foreign language teacher preparation programs can strengthen digital competencies and improve technological readiness. Simultaneously, Techasermwattanakul and Suwannatthachote (2023) confirmed that GenAI

serves as a valuable tool to facilitate learning through the provision of interactive media and targeted feedback.

Manalu et al. (2023) confirmed that pedagogical training in the utilization of generative artificial intelligence tools, such as ChatGPT and Canva AI, significantly assisted mathematics teachers in Sentani in the development of interactive educational media, thus fostering creativity and student engagement. In Sidrap district, Ja'faruddin et al. (2023) saw that generative artificial intelligence training improved educators' digital competencies while facilitating opportunities for personalization of AI-driven learning experiences. Furthermore, Roe and Perkins (2024) emphasized that generative artificial intelligence has the potential to augment learner agency through customized educational experiences, albeit with the caveat of potential access disparities and implications for learner autonomy.

The investigation conducted by Ghimire et al. (2024) showed that, despite the increased awareness regarding Generative Artificial Intelligence (GenAI) among educational practitioners, concerns remain relating to the ethical implications of its application and the capacity to identify AI-generated content. Kildė (2024) also says that the main obstacle in the assimilation of GenAI lies in the insufficient training and readiness of educators to efficiently embrace this technological advancement. Noroozi et al. (2024) underline the necessity for a strong ethical framework and human oversight in the application of GenAI to guarantee precision and equity in the educational domain.

In Indonesia, the integration of Generative Artificial Intelligence (GenAI) in the education sector is currently in its infancy. Nevertheless, initiatives such as professional development programs at MTs YPKP Sentani (Manalu et al., 2023) and SMPN 11 Sidrap Regency (Ja'faruddin et al., 2023) show significant promise in improving educators' digital capabilities. However, challenges such as infrastructure shortages and inadequate training continue to pose major obstacles to the successful incorporation of GenAI in Madrasah Ibtidaiyah.

Analysis of various academic investigations shows that Generative Artificial Intelligence (GenAI) has significant potential to improve digital literacy and pedagogical efficacy. However, there is a lack of scholarly discourse on the application of GenAI in Madrasah Ibtidaiyah, particularly within the Indonesian educational framework. The majority of existing research mainly concentrates on higher education institutions or public educational institutions, whereas scientific investigations on the incorporation of GenAI in the professional development of MI educators are still very rare. Consequently, this investigation seeks to examine the prospects and barriers associated with the integration of GenAI in the educational training of Madrasah Ibtidaiyah instructors, with an emphasis on advancing digital literacy and improving teachers' technological readiness.

B. METHOD

This study uses a library research or integrative review approach that aims to systematically integrate the results of previous studies to identify opportunities and challenges in the application of generative artificial intelligence (GenAI) in Madrasah Ibtidaiyah teacher education. This approach allows researchers to examine relevant literature in depth to produce a conceptual synthesis and significant empirical findings. The integrative

review method is appropriate for evaluating and interpreting multiple sources of information from relevant academic literature in a comprehensive manner (Torraco, 2016).

The data sources in this study come from reputable academic databases such as Google Scholar, Scispace, DOAJ, and Scopus. The literature referenced was limited to articles published between 2015 and 2024, both in national and international journals. Inclusion criteria for selection included: articles that addressed AI/GenAI integration in education, teacher training, and improving digital literacy. Exclusion criteria included articles that were not available in full text, not peer-reviewed, and did not explicitly address topics related to the objectives of this study.

The literature search process was conducted using keywords such as: "Generative AI in Teacher Education", "AI Literacy for Primary Education Teachers", "Integrating Chatgpt in Classroom", and "Digital Competence in Islamic Schools". The literature selection process was conducted in two stages: first, selection based on title and abstract; second, full content selection to identify matches with the research focus. The selected articles were then analyzed using the thematic synthesis technique, which allowed the researcher to find patterns, themes, and interrelationships between research results.

To ensure validity and reliability, source triangulation was conducted by comparing findings from articles from reputable journals and across countries. In addition, the literature selection process was conducted systematically by recording each stage using an explicit protocol to enable replication of this study. Content validity was also strengthened by referring to current and relevant studies that have been empirically tested.

C. RESULTS AND DISCUSSION

1. Readiness and Perception of Madrasah Ibtidaiyah Teachers towards Integrating Generative Artificial Intelligence

The integration of generative artificial intelligence in the education curriculum at Madrasah Ibtidaiyah (MI) has received increasing attention in recent research. Teachers' willingness and perception of this technology can affect its implementation as well as the effectiveness of the education delivered to students. Some studies show that there are challenges in understanding and integrating this new technology into the learning process. One study by Murniyetti et al. explored teachers' responses to the use of artificial intelligence in Islamic religious education, and found that most teachers had a positive attitude towards the application of AI in learning, despite constraints in the knowledge and technical skills required to implement it effectively (Murniyetti et al., 2024). This is in line with research conducted by Maudyna et al., which revealed that teachers' readiness to use technology-based modules or teaching materials, including AI, is still at varying levels, with many teachers not feeling adequately prepared (Maudyna et al., 2023). This research points to the need for training and professional development to improve teachers' readiness to deal with technological change in the classroom.

Teachers' perceptions of AI integration are also influenced by other factors such as the leadership of the madrasah head and the madrasah culture itself. According to Mulyadi et al. there is a significant relationship between teachers' perceptions of madrasah leadership and

their performance, which has an impact on acceptance of innovative changes such as AI integration (Mulyadi et al., 2022). Research by Sari et al. showed that perceptions of the madrasah head's managerial competence can influence teachers' motivation in performing their duties and adopting new technologies (Sari et al., 2023). Thus, strong managerial support is critical in optimizing the integration of new technologies including AI in the curriculum.

Meanwhile, the character approach integrated in MI education also plays a role in how teachers deal with changes in the curriculum. Zahra and Aminah showed that character education has been systematically integrated in the curriculum, which can support teachers' readiness to deal with technology integration, including the use of AI in learning (Zahra & Aminah, 2024). Thus, educational character and technology can go hand in hand, supporting each other in creating a more meaningful learning environment. Finally, to achieve effective integration of generative artificial intelligence in learning, it is important to carry out continuous training and provide sufficient resources to teachers. Only by equipping teachers with the necessary knowledge and expertise can we ensure that they are ready to integrate AI into the teaching process, improving student engagement and learning outcomes in Madrasah Ibtidaiyah.

2. Application of Generative Artificial Intelligence in Educational Practice at Madrasah Ibtidaiyah

The application of generative artificial intelligence (AI) in educational practices in Madrasah Ibtidaiyah (MI) shows great potential to improve learning effectiveness and classroom management. Several recent studies provide insights into how this technology, if applied strategically, can modernize education at the primary level. Artificial intelligence offers a range of tools that can be used to structure more efficient and contextualized lesson planning. According to Serdianus and Saputra's research, the application of AI such as ChatGPT can assist teachers in crafting lesson plans that are timely and in line with student needs (Serdianus & Saputra, 2023). This overcomes common problems that teachers often face, such as lack of time and difficulty in finding relevant materials. With the help of AI, teachers can focus more on the more creative and interactive aspects of teaching, which can have a positive impact on student engagement.

Training in the use of AI is also key to its successful implementation in the MI environment. In a study by Thamrin et al., it was revealed that training designed for lecturers in the application of AI at UMMAD showed a significant increase in participants' understanding and skills (Thamrin et al., 2024). The same can be applied in MI, where targeted training for teachers will improve their readiness to use this technology in the classroom. In addition, the use of AI-based applications can also enrich students' learning experience. Af'idah et al. reported that the use of these technologies in education can improve students' understanding and skills relevant to current industry needs (Af'idah et al., 2024). By integrating AI applications into the curriculum, MI can provide students with more relevant and applicable learning experiences in the real world.

However, there are challenges to be faced, including limited resources, teacher expertise, as well as ethical constraints that may arise with the implementation of new technologies. Murti and Sabarudin note that transformational leadership is needed to facilitate the implementation of new technologies and ensure that teachers are supported in overcoming these challenges (Murti & Sabarudin, 2023). By developing the leadership capabilities of madrasah heads, it is hoped that an environment that supports educational innovation through technology can be created.

The application of AI in the context of Madrasah Ibtidaiyah must also consider the moral and ethical dimensions, especially in the context of character education. This is important to maintain a balance between technological advancement and the educational values that are to be instilled. With curriculum development that enhances the capacity of teachers and engages students in technology-based learning processes, it is hoped that the younger generation remains grounded in strong character in the face of the digital era. Overall, the application of generative artificial intelligence in Madrasah Ibtidaiyah not only has the potential to improve the quality of education, but also encourage innovation and ensure the relevance of the curriculum to the conditions and demands of the 21st century. To realize this, cooperation between the government, educational institutions, and the community is needed to provide adequate resources and create a supportive learning environment.

3. Ethical Challenges and Implications in the Use of GenAI in the Islamic Education Environment

The application of generative artificial intelligence (GenAI) in Islamic education brings various ethical challenges and empowerments that need to be carefully considered. One of the main challenges is how to maintain the integrity of Islamic values in the midst of this technological advancement. On the one hand, GenAI can be a valuable tool in enriching the learning process through personalization, but on the other hand, there is a risk that its use may lead to a distortion of the understanding of religious teachings. According to Johan et al., Islamic education is at the crossroads of tradition and modernity, which creates challenges in maintaining core religious values in an increasingly secularized and dynamic situation Johan et al. (2024). The rapid development of technology often goes against the traditional way of teaching spiritual values, triggering confusion and ambiguity for students in the digital age. With the implementation of GenAI, teachers need to be more aware of AI-curated information that may not always be in line with Islamic principles.

Another ethical challenge is related to data privacy and security. In education that utilizes AI, student data is often collected to improve the learning experience. However, Fathurrohman and Rizqi underline the importance of ensuring that policies to protect students' personal data are strictly implemented (Fathurrohman & Rizqi, 2021). This is important to avoid data protection that could harm students and violate the code of conduct in the educational context. In addition, skepticism towards technology can also be a barrier. Sulistiawati and Abidin note that although multimedia technology can facilitate more engaging learning experiences, not all educators are ready or willing to adopt these new technologies (Sulistiawati & Abidin, 2024). This has the potential to create gaps in teaching,

with only some students benefiting from such innovations, raising issues of inequity in the education system.

Broader ethical implications of using GenAI include the potential biases that may exist in AI algorithms. Sodik noted that the application of AI without proper supervision could reinforce injustice and discrimination in education (Sodik, 2024). Ethical considerations must be integrated into the design and use of GenAI, followed by adequate training for educators to understand and effectively address these issues. As a step towards meeting this challenge, a collaborative approach between educational institutions, educators and technology developers is needed. Nurohman et al. emphasize the importance of cooperation between education, industry, and the community in providing the training and resources necessary to prepare educators for the rapidly changing technological era (Nurohman et al., 2024). This process should also include in-depth character education for students, so that they can be ethical and moral in using technology in their daily lives, including when interacting with AI systems.

D. CONCLUSIONS AND SUGGESTIONS

The integration of generative artificial intelligence (GenAI) in Madrasah Ibtidaiyah teacher education offers significant opportunities in improving learning effectiveness, teacher work efficiency and educational innovation. However, teacher readiness, infrastructure limitations, and ethical and religious values challenges are obstacles that need to be overcome. Character education that has been integrated in the MI curriculum has the potential to be a strong foundation in directing the wise and meaningful use of GenAI. The success of this integration is highly dependent on continuous training, supportive policies, and collaboration between educational institutions, government, and society.

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