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DIGITAL DIALECTICS AND ISLAMIC EDUCATION: A STUDY ON THE APPLICATION OF GEMINI AI IN MATHEMATICS LEARNING ORIENTED TOWARDS ISLAMIC VALUES

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ABSTRACT

This study aims to analyze the integration of Gemini AI in mathematics learning oriented toward Islamic values, drawing on constructivist learning, AI pedagogy, and Islamic moral education perspectives. This study employed a quasi-experimental design using a one-group pretest–posttest approach. The study was conducted through a socialization program involving teachers as participants. Data were collected using questionnaires to measure teachers' understanding and abilities before and after the intervention. The results indicate a significant improvement in teachers' understanding of Gemini AI, with the mean score increasing from 2.45 (low category) to 4.12 (high category). In addition, teachers' ability to integrate AI into learning was categorized as high, with an average score of 3.98, where 76% of teachers were in the high category. The findings indicate that the integration of Gemini AI is associated with increased teacher understanding and perceived ability to implement AI in learning. In addition, teachers reported that AI can facilitate the incorporation of Islamic values such as honesty, responsibility, and justice into instructional contexts. These findings suggest that value-based AI utilization can serve as a strategic innovation in improving learning effectiveness while fostering students' character development.

Keyword: *Artificial Intelligence, Gemini AI, Mathematics Pedagogy, Islamic Education.*

A. Introduction

The rapid advancement of Artificial Intelligence (AI) over the past decade has significantly transformed educational paradigms, shifting from conventional teacher-centered approaches to adaptive, personalized, and data-driven learning environments (Nasihuddin, 2024). The emergence of generative AI technologies, including Gemini AI, enables both teachers and students to access instant explanations, simulations, and problem-solving assistance in a contextual and interactive manner (Zenab, Anggraeni, & Putti 2025). In the context of mathematics education, this transformation is particularly given the abstract, hierarchical, and often challenging nature of mathematical concepts (Ayu et al., 2025).

Recent studies indicate that the integration of AI in mathematics learning can enhance conceptual understanding, critical thinking skills, and student engagement (Chen et al., 2020; Hwang & Tu, 2021). AI not only functions as an instructional tool but also as a cognitive partner that provides adaptive feedback tailored to students' learning needs. However, the increasing emphasis on technological efficiency in education risks neglecting the moral and value-based dimensions of learning if not carefully integrated.

In Islamic education, particularly in Madrasah Tsanawiyah, the goals of education extend beyond cognitive achievement to include character building and the internalization of Islamic values (Indah & Hidayah 2025). Core values such as honesty (ṣidq), responsibility (amanah), discipline (intiẓām), and ethical reasoning form an integral part of the learning process (Anita, 2025). Therefore, the integration of AI technologies in mathematics instruction within madrasahs cannot be value-neutral; instead, it must actively reinforce these Islamic principles.

A critical issue that arises is the gap between the rapid adoption of AI technologies and the pedagogical as well as ethical readiness of educators. Many implementations of AI in education remain focused primarily on cognitive and efficiency aspects, with limited attention to ethical, spiritual, and character development. Additionally, uneven levels of teachers' digital literacy and concerns regarding the misuse of AI such as plagiarism and over-reliance pose significant challenges in the effective implementation of AI in madrasah settings.

To provide a stronger theoretical foundation, this study is informed by the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the integration of technology, pedagogy, and subject content in effective teaching practices. In the context of AI integration, TPACK highlights that teachers are required not only to master technological tools such as Gemini AI, but also to align them with appropriate pedagogical strategies and mathematical content. This framework is particularly relevant in understanding how teachers design meaningful and contextually appropriate AI-supported learning.

In addition, this study is grounded in value-based education from an Islamic epistemological perspective, which views knowledge as inseparable from moral and spiritual dimensions. Islamic epistemology emphasizes the unity of knowledge (tauhid), where cognitive development must be integrated with ethical values such as honesty (ṣidq), responsibility (amanah), and justice (‘adl). Therefore, the integration of AI in madrasah education should not be value-neutral but must actively contribute to the formation of students’ character and moral awareness.

On the other hand, Gemini AI, as an advanced generative AI system, offers substantial potential to support more contextual and interactive learning experiences (Oka Alvansyah et al., 2025) With its ability to process natural language, generate multimodal explanations, and adapt responses based on context, Gemini AI can be utilized to connect mathematical concepts with real-life applications as well as Islamic contexts, such as zakat calculations, inheritance laws (farā’iḍ), and principles of fairness and justice.

Despite these potentials, existing studies largely focus on the general application of artificial intelligence in education without explicitly addressing the integration of generative AI with religious or value-based pedagogical frameworks, particularly in Islamic educational settings. Furthermore, empirical research examining how AI technologies are aligned with both pedagogical competence and moral education in secondary-level madrasah contexts remains very limited. To the best of current knowledge, no empirical study has specifically investigated the integration of generative AI, such as Gemini AI, with Islamic value-based pedagogy in secondary Islamic education. This gap highlights the need for research that not only explores technological innovation but also examines its alignment with ethical and spiritual dimensions of learning.

Based on this background, this study aims to: (1) analyze how Gemini AI is utilized in mathematics learning in Madrasah Tsanawiyah; (2) examine how Islamic values are integrated into the use of AI; and (3) identify the challenges and opportunities associated with implementing Gemini AI in value-based educational contexts. This study is expected to contribute both theoretically and practically to the development of AI-based mathematics learning models that are not only technologically innovative but also grounded in Islamic values.

This study employed a pre-experimental quantitative design using a one-group pretest–posttest approach to examine the effect of Gemini AI integration in mathematics learning oriented toward Islamic values. The participants consisted of 30 teachers from Madrasah Tsanawiyah who were involved in a structured socialization program. Data were collected using a questionnaire designed to measure teachers’ understanding of Gemini AI and their ability to integrate it into instructional practices, including the incorporation of Islamic values.

The validity of the instrument was established through expert judgment, involving experts in educational technology and Islamic education to ensure the relevance and clarity of the items. Meanwhile, the reliability of the instrument was assessed using internal consistency analysis (Cronbach's Alpha) to ensure the consistency of the measurement, although the results are interpreted descriptively in line with the study design. Data analysis was conducted using descriptive statistics, including mean scores and percentage distributions, to describe changes in teachers' understanding and abilities before and after the intervention. The comparison between pretest and posttest results was used to identify the magnitude of improvement following the program.

The intervention was implemented through several stages. First, a pretest was administered to assess teachers' initial understanding of Gemini AI. Second, the socialization stage introduced the concept of artificial intelligence, the use of Gemini AI in mathematics learning, and strategies for integrating Islamic values. Third, in the practice stage, teachers were guided to apply Gemini AI in developing learning materials and contextual mathematical problems. Finally, a posttest was conducted to evaluate changes in teachers' understanding and abilities after the intervention.

B. Artificial Intelligence in Education

Artificial Intelligence (AI) in education refers to the use of computational systems capable of simulating human intelligence such as learning, reasoning, problem-solving, and decision-making to support and enhance educational processes (Oktavianus & Rantung 2023). In recent years, AI has evolved from a mere administrative support tool into an intelligent system that functions as an adaptive and personalized learning facilitator.

Conceptually, AI in education encompasses various technologies, including machine learning, natural language processing (NLP), learning analytics, and intelligent tutoring systems. These technologies enable systems to analyze learning data in real time, identify individual students' needs, and provide tailored feedback. Consequently, AI not only improves learning efficiency but also enhances the overall quality of the learning experience (Athallah, n.d.).

In practice, AI contributes to several key aspects of education. First, personalized learning, where AI adapts content, pace, and instructional methods according to students' abilities and learning styles. Second, automated assessment, which allows for rapid and accurate evaluation of student performance. Third, adaptive learning support, where systems recommend additional materials or exercises based on students' progress and performance.

Furthermore, the emergence of generative AI, such as Gemini AI, introduces a new dimension to education. Unlike conventional AI, generative AI can produce new content, including conceptual explanations, practice problems, and dynamic

learning simulations. This capability enables more natural human–machine interaction and supports inquiry-based and exploratory learning approaches.

However, the implementation of AI in education is not without challenges. Key concerns include ethical issues such as algorithmic bias, data privacy, and the risk of over-reliance on technology. Additionally, teachers' readiness to integrate AI into instructional practices remains a critical factor. Teachers are no longer merely knowledge transmitters but must act as facilitators who guide the responsible and critical use of technology.

In value-based educational contexts, such as Madrasah Tsanawiyah, the use of AI should not be limited to enhancing cognitive outcomes but must also strengthen affective and moral dimensions. Therefore, AI integration must align with Islamic values as a foundational framework in the learning process. In this sense, AI serves not only as a technological tool but also as a medium for character and ethical development (Afifah & Iskandar 2025).

In conclusion, AI in education represents a strategic innovation with significant potential to transform learning. Nevertheless, its implementation requires a holistic approach to ensure alignment with broader educational goals, including the development of character and values.

C. Artificial Intelligence (AI) in Mathematics Learning

Artificial Intelligence (AI) has become an important innovation in mathematics learning, particularly in addressing various challenges related to the abstract nature of mathematics and differences in students' learning abilities. Mathematics learning requires logical thinking skills, conceptual understanding, and high-level problem-solving abilities, which are often difficult to achieve through conventional teaching methods. In this context, AI offers a new approach that can enhance learning effectiveness as well as student engagement (Kaluge, n.d.).

One of the main contributions of AI in mathematics learning is its ability to provide personalized learning (Mardianingsih & Harisman 2025). AI-based systems can analyze student performance data and adjust learning materials, difficulty levels, and learning pace according to individual needs (Rizvi, 2023). This adaptive capability enables students to receive more targeted support, thereby improving conceptual understanding and minimizing learning gaps.

In addition, AI supports more interactive and visual learning. Through simulations, dynamic representations, and step-by-step guidance in problem solving, AI helps students understand abstract mathematical concepts in a more concrete way. This is especially important in topics such as algebra, geometry, and calculus, which require visualization in the learning process.

AI also plays a role in developing higher-order thinking skills (Aslam, 2025). With immediate feedback and the presentation of various alternative solutions,

students are encouraged to reflect on their thinking processes and explore different problem-solving strategies. This aligns with the demands of 21st-century learning, which emphasize critical, creative, and analytical thinking skills.

Furthermore, the presence of generative AI such as Gemini AI provides a new dimension in mathematics learning. This technology enables teachers to generate problems, explanations, and learning contexts that are more varied and contextual. In the Madrasah Tsanawiyah environment, AI can be utilized to connect mathematics materials with Islamic values, such as zakat calculation, inheritance distribution (farā'iḍ), and the concept of fairness in distribution.

However, the implementation of AI in mathematics learning also presents challenges. These include the potential for student dependency on AI, the possibility of errors in system-generated outputs, and the need for teachers' competence in verifying and guiding the proper use of AI. Therefore, the role of teachers remains crucial as facilitators who ensure that AI is used as a supportive tool.

D. Islamic Values in Education

Islamic values in education constitute a set of normative principles derived from the Qur'an and Hadith, which function as a foundation for shaping students' personalities holistically, encompassing cognitive, affective, and psychomotor aspects. Education from an Islamic perspective is not only oriented toward the transfer of knowledge but also toward character building and spiritual development, maintaining a balance between worldly life and the hereafter. Conceptually, Islamic values in education can be classified into three main dimensions: aqidah (faith), sharia (law and practice), and akhlaq (morality).

1. Aqidah Values (Faith)

Aqidah values represent the primary foundation in Islamic education, emphasizing belief in Allah, angels, holy books, prophets, the Day of Judgment, and divine decree (qadar) (Afifah et al., 2025). Aqidah-based education aims to develop a strong sense of tawhid (monotheism), enabling students to have a clear life orientation and resilience against the negative influences of globalization. In the context of modern education, aqidah values also play a role in fostering integrity and ethical awareness in dealing with technological advancements, including artificial intelligence. According to Halstead (2004), Islamic education emphasizes the importance of internalizing faith-based values as the basis for moral decision-making and social behavior.

2. Sharia Values (Religious Practice and Law)

Sharia values relate to the implementation of Islamic teachings in daily life, both in the form of mahdhah worship (rituals) and muamalah (social interactions).

In education, these values are manifested through the habituation of disciplined behavior, responsibility, and adherence to rules.

The integration of sharia values in learning can be carried out through strengthening worship practices such as prayer, promoting academic honesty (e.g., avoiding cheating), and fostering ethics in social interactions. This aligns with the view that Islamic education should integrate theory and practice (integration of knowledge and action).

3. Akhlaq Values (Morality and Ethics)

Akhlaq values are the concrete manifestation of aqidah and sharia in behavior. Moral education aims to cultivate noble character (akhlaqul karimah), such as honesty, trustworthiness, discipline, responsibility, and tolerance.

In a global context, akhlaq-based education is crucial in addressing the challenges of moral degradation due to modernization. Saeed (2018) asserts that Islamic education should develop universal ethical dimensions such as justice, compassion, and respect for others.

4. Improving Conceptual Understanding

The use of Gemini AI in mathematics learning provides a significant contribution to improving students' conceptual understanding, especially in abstract and complex topics. In conventional learning, teachers often face limitations in delivering varied explanations, making it difficult for all students to fully grasp the material. The presence of Gemini AI offers an innovative solution by providing more interactive, multimodal explanations (text, images, and simulations) tailored to students' learning needs.

Through its generative capabilities, Gemini AI assists teachers in simplifying difficult mathematical concepts into more concrete and easily understandable forms. For example, concepts such as functions, limits, or geometry can be visualized through illustrations or contextual examples related to everyday life. This aligns with constructivist theory, which emphasizes that conceptual understanding becomes stronger when students can connect new knowledge with their prior experiences. Thus, Gemini AI functions not only as a supporting tool but also as a facilitator in developing deeper conceptual understanding.

In addition, Gemini AI enables personalized learning, where each student can learn according to their own pace and learning style. Students who face difficulties can request repeated explanations using different approaches, while those who grasp concepts more quickly can directly access advanced-level problems. This flexibility is crucial in addressing ability gaps within the classroom, making the learning process more inclusive and effective.

The use of Gemini AI also helps reduce misconceptions that frequently occur in mathematics learning. With real-time feedback, students can immediately

identify errors in their thinking processes and receive appropriate clarification. This strengthens conceptual understanding rather than mere memorization of problem-solving procedures. Research shows that the integration of artificial intelligence in education can enhance learning quality by providing adaptive and responsive support to students' needs (Zawacki-Richter et al., 2019; Chen et al., 2020).

Furthermore, Gemini AI encourages active student engagement in the learning process. Dynamic interaction between students and the AI system makes learning more engaging and less monotonous. Students are not merely passive recipients of information but become active participants in exploring concepts, asking questions, and independently discovering solutions. This condition ultimately leads to deeper and more sustainable understanding.

E. Integration of Islamic Values and Strengthening Digital Ethics

The integration of Islamic values in mathematics learning is an approach aimed at connecting scientific concepts with spiritual values and practical aspects of life in Islam. In this context, teachers do not merely deliver mathematical material theoretically but also relate it to relevant Islamic contexts, such as zakat calculation, inheritance distribution (faraidh), determining the direction of the qibla, and calculating prayer times. This approach makes learning more meaningful, as students can directly see the application of mathematics in their religious lives.

Through this integration, mathematics is no longer viewed as an abstract discipline detached from life values, but rather as a tool to understand and practice Islamic teachings more accurately. For instance, in arithmetic and percentage topics, students can learn how to calculate zakat maal or zakat fitrah. Meanwhile, in fractions, students can understand the concept of inheritance distribution according to sharia principles. This not only enhances students' cognitive understanding but also strengthens their religious awareness and Islamic values in daily life.

Furthermore, the integration of Islamic values plays an important role in shaping students' moral character. Learning that incorporates values such as honesty, justice, and responsibility encourages students not only to understand mathematical concepts but also to internalize the moral values embedded within them. Thus, education becomes a means of developing individuals who are not only intellectually capable but also possess strong spiritual and social integrity.

In the digital era, the use of technologies such as Gemini AI can further strengthen this integration by presenting contextual examples based on Islamic values in a more varied and interactive manner. Teachers can utilize AI to generate zakat-based problems, inheritance distribution simulations, or case studies

relevant to the lives of Muslim students. This makes learning more engaging, contextual, and aligned with the needs of students in madrasah education.

The use of Gemini AI in mathematics learning is not only focused on improving cognitive aspects but also plays an important role in strengthening students' digital ethics. In the era of digital transformation, students are faced with easy access to information and advanced technologies which, if not accompanied by proper ethical understanding, may lead to various issues such as plagiarism, excessive dependence on technology, and misuse of AI in completing academic tasks. Therefore, the use of AI must be directed toward upholding academic honesty and responsibility.

Teachers have a strategic role in guiding students to use AI wisely and responsibly. In this context, Gemini AI should be positioned as a learning aid rather than a substitute for students' thinking processes. Students need to be encouraged to understand that AI-generated outputs must be critically analyzed, comprehended, and further developed independently. Thus, the use of AI becomes a means to train critical thinking skills rather than merely a shortcut to obtain answers.

Moreover, strengthening digital ethics includes instilling values such as honesty, integrity, discipline, and responsibility in the use of technology. From the perspective of Islamic education, these values align with the principles of akhlaqul karimah, which should be applied in all aspects of life, including digital activities. Students should be accustomed to avoiding copying answers without understanding, properly citing sources, and using technology in a balanced and responsible manner.

The use of Gemini AI can also be directed toward enhancing students' awareness of ethical boundaries in technology utilization, such as the importance of protecting data privacy, respecting intellectual property rights, and avoiding the spread of misinformation. With proper guidance, students can become not only intelligent technology users but also ethical and responsible individuals.

F. The Socialization of Gemini AI Integration in Mathematics Learning

The results of the socialization activity on integrating Gemini AI into mathematics learning based on Islamic values in Madrasah Tsanawiyah were analyzed using a descriptive quantitative approach. This approach was chosen to provide a systematic, measurable, and objective overview of teachers' levels of understanding, abilities, and responses toward the implementation of artificial intelligence technology in value-based learning contexts. Descriptive quantitative analysis enables researchers to identify data trends through mean scores, frequency distributions, and assessment categories that represent empirical conditions in the field.

1. Teachers' Level of Understanding of Gemini AI

Based on the analysis results, there was a significant improvement in teachers' understanding before and after the socialization. The results can be seen in the table below :

Table 1. Teachers' Understanding of Gemini AI Before and After Socialization

No	Assessment Aspect	Mean Score	Category
1	Before Socialization	2,45	Low
2	After Socialization	4,12	High

Before the socialization, the mean score was 2.45, which falls into the low category. This indicates that the level of understanding, readiness, or ability of respondents (teachers) regarding the material or technology introduced was still limited. In other words, prior to the activity, most respondents did not yet have adequate competence.

After the socialization, the mean score increased to 4.12, categorized as high. This improvement shows a significant positive change among respondents. They became more knowledgeable, better prepared, and more capable of applying the knowledge provided.

Overall, the comparison of these two scores confirms that the socialization activity was highly effective in improving teachers' understanding and competence. This is evident from the increase in the mean score by 1.67 points, indicating a substantial impact of the intervention. The comparison between pretest (M = 2.45) and posttest (M = 4.12) indicates a substantial increase in teachers' understanding after the intervention. The mean difference of 1.67 suggests a strong practical effect of the socialization program. Although this study primarily employs descriptive analysis, the magnitude of change reflects a meaningful improvement in participants' competence.

Table 2. Distribution of Teachers' Understanding Categories After Socialization

No	Category	Number of Teachers	Percentage
1	High	25	83%
2	Medium	5	17%
3	Low	0	0%
Total		**30**	**100%**

The majority of teachers fall into the high category, with 25 teachers (83%). This indicates that most teachers have a very good level of understanding, skills, and readiness regarding the material presented. This achievement reflects the high

effectiveness of the program. Furthermore, 5 teachers (17%) are in the medium category, indicating that a small proportion of teachers have sufficient but not yet optimal understanding or ability. They may still require further guidance or reinforcement.

Meanwhile, no teachers (0%) fall into the low category, meaning that all participants have met at least the minimum expected standard. This is a positive indicator that the program successfully elevated all participants' competence. Overall, this distribution demonstrates that the activity was highly successful, with a dominance of the high category and the absence of the low category, indicating a very positive impact on improving teachers' competence.

2. Teachers' Ability to Integrate AI in Learning

Advancements in digital technology, particularly in the field of Artificial Intelligence (AI), have brought significant changes to education. Teachers are required not only to understand conventional teaching concepts but also to effectively integrate AI technology into the learning process. This integration includes the ability to design innovative learning activities, develop AI-based assessment items, and utilize platforms such as Gemini AI to enhance the quality of classroom instruction.

In this context, evaluating teachers' ability to integrate AI is essential to determine the extent of their readiness and competence in facing technology-driven educational transformation. The results of this assessment are presented to provide a clearer picture of teachers' ability levels and their distribution.

Based on the evaluation results, teachers' ability to integrate AI in learning shows a strong performance, with an average score of 3.98, categorized as high. This indicates that most teachers already possess adequate competence in utilizing AI technology in the learning process.

In terms of distribution, the majority of teachers (76%) fall into the high category, while the remaining 24% are in the medium category. This condition shows that almost all teachers are capable of implementing AI in learning, although some still require further improvement. The findings can be interpreted through the lens of constructivist learning theory, which emphasizes that knowledge is actively constructed through interaction and experience. The use of Gemini AI allows teachers to explore mathematical concepts in more interactive and contextual ways, supporting the idea that learning becomes more meaningful when individuals actively engage with content rather than passively receiving information. From the perspective of AI-assisted cognition, Gemini AI functions as a cognitive partner that supports teachers in generating explanations, examples, and learning materials. This aligns with the notion that AI can augment human thinking by providing adaptive and immediate feedback, thereby enhancing instructional design and pedagogical decision-making.

Furthermore, the integration of Islamic values in this study reflects the principles of Islamic moral pedagogy, where education is not limited to cognitive development but also includes ethical and spiritual dimensions. The findings indicate that teachers are able to contextualize mathematical content within Islamic values, although this study focuses on teachers' perceptions rather than direct measurement of students' moral outcomes.

G. Conclusion

Based on the findings, this study concludes that the integration of Gemini AI in mathematics learning at Madrasah Tsanawiyah is associated with a meaningful improvement in teachers' understanding and perceived ability to utilize AI in instructional practices. The results indicate that the socialization program contributed to increased readiness among teachers to adopt AI-supported learning approaches.

This study contributes to the development of AI as value-mediated pedagogy, where artificial intelligence is not positioned as a value-neutral tool but as a medium that can facilitate the integration of cognitive and moral dimensions in education, particularly within the framework of Islamic values. This highlights the potential of AI to support not only instructional effectiveness but also value-oriented learning when guided by appropriate pedagogical frameworks. However, this study has several limitations. First, the use of a pre-experimental design without a control group limits the ability to establish causal relationships. Second, the relatively small sample size (n = 30) restricts the generalizability of the findings. In addition, the study focuses on teachers' perceptions and does not directly measure student learning outcomes or character development. Therefore, future research is recommended to employ more rigorous designs, such as true experimental or quasi-experimental studies with control groups, to better examine the causal impact of AI integration.

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