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From Bayt Al-Hikmah to The Era of Artificial Intelligence (AI): Epistemological Transformation of Knowledge and Its Relevance for Scientific Integration in Islamic Education

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Abstract:
The transformation of knowledge from the classical Islamic tradition to the modern era and Artificial Intelligence (AI) demonstrates not only the growth of knowledge but also shifts in its sources, methods, validity, and authority. However, studies on Bayt al-Hikmah, the development of modern science, Islamic epistemology, and AI in Islamic education tend to be discussed in separate domains. Consequently, the connection between these epistemological transformations and scientific integration in Islamic education has not been systematically examined. This study aims to analyze the epistemological transformation of knowledge from classical scholarly traditions through Bayt al-Hikmah, the development of modern science, to the AI era, and to examine its relevance to scientific integration in Islamic education.
This study employs a qualitative approach with a library research method. Literature was analyzed descriptively and analytically across four dimensions: sources, methods, validity, and authority of knowledge. The findings indicate that Bayt al-Hikmah represents an open scientific paradigm toward various traditions through translation, dialogue, critique, and knowledge development. Modern science subsequently reinforced scientific methods, observation, experimentation, and empirical proof, though the rise of specialization also risks driving scientific fragmentation.
The contribution of this study lies in its continuous reading of these transformations through four epistemological dimensions and their connection to the integrative-interconnective paradigm in Islamic education. In this context, scientific integration needs to connect revelation, reason, empirical experience, technology, and ethical and spiritual values. AI should be positioned as an instrument for knowledge development that remains subject to human verification, interpretation, and ethical judgment.

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Introduction (مقدمة)

The development of science and knowledge basically shows not only an increase in the information possessed by humans, but also a shift in how humans acquire, test, and determine the truth of knowledge. Every historical period has a distinct way of understanding the sources of knowledge, the methods used, and the entities considered to hold the authority to determine truth. Therefore, the history of science can be understood as a history of epistemological shifts that continuously evolve alongside changes in society, culture, and technology. In the educational context, these shifts are crucial to observe because the way a society understands knowledge will influence how knowledge is taught and developed.

In the historical development of science, Islamic civilization played a pivotal role in bringing together various scientific traditions. One important milestone is seen during the Abbasid period through translation, study, and development of various works from Greek, Persian, and other scientific traditions. Bayt al-Hikmah became a primary symbol of this process because scientific activities did not stop at translation, but expanded through analysis, critique, and knowledge development. Thus, the Islamic scientific tradition demonstrates that scientific growth can occur through the relationship between diverse sources and traditions of knowledge, rather than through the division between scientific fields.

This pattern remains relevant to contemporary scientific challenges. The growth of modern science has strengthened the use of scientific methods, observation, experimentation, and proof as the basis for knowledge development. However, scientific advancements have also led to strong specialization, causing various fields of knowledge to develop in isolation. In Islamic education, this issue manifests as a dichotomy between religious sciences and general sciences. Research conducted by (Habibatul Imamah, 2025) indicates that this fragmentation can diminish the holistic character of Islamic education, as intellectual knowledge is not always connected to spiritual and ethical dimensions.

These epistemological challenges have become increasingly complex with the rise of Artificial Intelligence (AI). AI is no longer utilized merely to store and convey information; it is now capable of generating text, providing answers, analyzing data, and assisting in various intellectual activities. This transformation enables AI to influence how knowledge is produced, disseminated, and trusted. In Islamic education, the issue is not merely about the capability to use technology, but also about determining the position of AI in the process of acquiring and validating knowledge.

This situation shows that AI development must be understood not only as a technological shift, but also as an epistemological transformation. In Islamic education, AI needs to be positioned in relation to revelation, reason, experience, values, and scholarly authority. For instance, (Yusgiantara & Baidi, 2025) highlight the importance of an integrative-interconnective epistemological framework in connecting AI with Islamic education so that technology usage is not merely technically oriented, but also considers ethical and epistemological dimensions. Furthermore, other studies emphasize that integrating AI into Islamic education must maintain a Qur'anic orientation, digital ethics, and humanistic dimensions in the learning process (Hermawan et al., 2026) .

Based on these issues, this article argues that the epistemological trajectory—from ancient traditions, the expansion of Islamic scholarship through Bayt al-Hikmah, modern science, to the AI era—must be read as a process of transformation in the sources, methods, validation, and authority of knowledge. This perspective is vital for re-examining the position of scientific integration within Islamic education. Integration should not be understood merely as an effort to merge religious and general sciences, but as an endeavor to build a critical and complementary relationship among various sources and methods of knowledge while remaining oriented toward

Islamic values. Therefore, this article aims to analyze the epistemological transformation of science from classical traditions to the AI era and to explain its relevance for the development of scientific integration in Islamic education.

Method (منهج)

This study utilizes a qualitative approach with a library research method. This method was chosen because the study centers on a conceptual analysis of the epistemological transformation of knowledge and its relevance to scientific integration in Islamic education. The data sources consist of scientific journal articles and relevant academic publications addressing the epistemology of science, Bayt al-Hikmah, modern science development, Artificial Intelligence (AI), Islamic epistemology, and scientific integration in Islamic education.

Literature searches were conducted via Chrome, Google Scholar, and Scopus. The keywords used were tailored to the research focus, including "epistemology of science," "Bayt al-Hikmah," "Islamic epistemology," "modern science," "artificial intelligence," "AI in Islamic education," "scientific integration," and "integrative-interconnective." These keywords were applied individually and in combination to retrieve literature addressing historical, epistemological, and educational dimensions of the topic.

Literature selection was governed by specific criteria. Inclusion criteria comprised: (1) publications directly relevant to the themes of epistemology of science, Bayt al-Hikmah, modern science, AI, or scientific integration in Islamic education; (2) peer-reviewed academic works with clearly identifiable publication metadata; (3) literature aligned with the analytical focus of the study; and (4) publications spanning 2021–2026 to strengthen contemporary discussions. Additionally, seminal works published prior to this timeframe were retained if they held foundational value for conceptual or theoretical frameworks. Literature lacking direct relevance, offering insufficient data, or discussing AI strictly from a technical standpoint without addressing epistemological or Islamic educational issues was excluded from primary analysis.

Data collection proceeded through four stages: retrieval, selection, reading, and documentation. In the retrieval stage, literature was collected based on established keywords. Next, sources were selected by reviewing titles, abstracts, content, and alignment with inclusion criteria. Selected texts were thoroughly read, and key sections related to sources, methods, validity, and authority of knowledge were extracted. All relevant data were documented to facilitate comparative analysis and synthesis.

Data analysis was carried out descriptively and analytically through identification, categorization, comparison, interpretation, and synthesis. First, literature was identified based on its contribution to epistemological transformation discussions. Second, extracted information was categorized into four analytical dimensions: sources of knowledge, methods of acquiring or producing knowledge, validity of knowledge, and authority of knowledge. Third, these four dimensions were compared across major evolutionary phases: classical traditions, Islamic scholarship during Bayt al-Hikmah, modern science, and the AI era. Fourth, comparative results were interpreted to highlight epistemological shifts and emerging challenges in each phase. Fifth, the results were synthesized to explain their relevance to the integrative-interconnective paradigm and the advancement of Islamic education, particularly across curriculum design, teacher roles, knowledge verification, and AI ethics.

Result (نتائج) and Discussion (مناقشة)

Epistemological Genealogy of Science: Ancient and Classical Traditions

Epistemology is a branch of philosophy that deals with the nature, sources, processes, limits, and validity of knowledge. In the context of the philosophy of science, epistemology does not merely analyze what qualifies as knowledge, but also how knowledge is acquired, through what methods it can be constructed, and on what basis a claim can be judged true or acceptable. Thus, epistemology fundamentally relates to the relationships between knowledge, sources of knowledge, methods of acquiring knowledge, criteria of truth, and the authority that determines the validity of knowledge (Aulia, 2022).

These epistemological problems actually emerged long before epistemology developed as a systematic philosophical discipline. In ancient societies, knowledge about nature, humanity, and life originally developed through experience, tradition, religious beliefs, mythology, and practical knowledge passed down through generations. Therefore, the early history of science is not best understood as a sudden process starting in Greece, because Egyptian, Babylonian, Indian, Chinese, and other ancient civilizations had already developed knowledge in mathematics, astronomy, medicine, and technology (Karyati & Nour, 2026).

Subsequently, a significant epistemological transition occurred in the Classical period, particularly in the Greek and Mediterranean regions. Natural philosophers such as Thales, Anaximander, and Pythagoras began to shift the paradigm of thought by proposing material and mathematical explanations for the structure of the universe without relying on supernatural intervention. This intellectual tradition peaked through the thoughts of Socrates, Plato, and Aristotle, who formulated the rules of formal logic, methodologies of biological classification, and frameworks for inductive and deductive reasoning. Knowledge was no longer passively accepted, but critically tested through dialectics and structured systematic thinking (Feke, 2024).

This demonstrates that scientific developments during the classical period cannot be rigidly separated from the development of philosophy. Philosophy provided questions regarding the nature of reality, causes, knowledge, and truth, while specific fields of science developed increasingly specialized ways to investigate particular objects.

However, the character of Greek epistemology does not mean that knowledge had become fully empirical in the modern sense of science. Rationality, observation, mathematics, philosophical thought, and even metaphysical elements were still intertwined in classical scientific practices. Therefore, this period is more accurately understood as the formative phase of scientific epistemology, when humans began developing an awareness that knowledge requires specific sources, methods, arguments, and validity criteria. This shift enabled knowledge to be not only inherited, but also debated, criticized, classified, and developed. In other words, scientific growth during the ancient and classical periods shows a shift from knowledge primarily received based on tradition to knowledge increasingly constructed through rationality, observation, and argumentation.

Bayt al-Hikmah and the Integrative Pattern of Islamic Scientific Epistemology

The epistemological transformation of science since ancient times did not stop at the Greek intellectual tradition, but experienced significant development when interacting with Islamic civilization. During the Abbasid Dynasty, particularly under Harun al-Rashid and al-Ma'mun, intellectual activities flourished through political support for translation, research, library development, and intercultural dialogue. In this context, Bayt al-Hikmah in Baghdad became an institution representing the growth of the Islamic scientific tradition. A historical study by (Az-

zahra et al., 2026) reveals that Bayt al-Hikmah did not merely function as a manuscript repository, but was deeply involved in translation, research, scientific development, and knowledge dissemination by scholars from various regions. Hence, its existence can be understood as part of an intellectual ecosystem that allowed knowledge from diverse civilizations to be brought together and expanded within an Islamic scholarly environment.

The translation movement during the Abbasid period brought together Greek, Persian, Indian, and other scientific intellectual heritages with the Islamic intellectual sphere. Translation became the initial phase of a broader process: reception, critical reading, development, and the production of new knowledge (Matin Shopwan Amarullah, 2024). Thus, this intercultural encounter showed that the advancement of science in Islamic civilization proceeded through a dialogical process. Foreign knowledge was not positioned simply as something to be rejected or passively accepted; rather, it was studied, tested, developed, and placed within an Islamic intellectual framework.

This pattern indicates an important shift from the mere transmission of knowledge to the transformation of knowledge. When works on philosophy, mathematics, astronomy, medicine, and other sciences were translated and studied, Muslim scholars did not stop at knowledge reproduction. They formulated new problems, methods, and findings according to their intellectual and civilizational needs. This tradition produced contributions from key figures such as al-Khwarizmi in mathematics, Ibn al-Haytham in optics, Ibn Sina in medicine and philosophy, and al-Biruni in astronomy and empirical studies (Nur, 2022). Consequently, the historical significance of Bayt al-Hikmah lies not merely in the vast number of manuscripts gathered or works translated, but in the creation of an environment that enabled various knowledge traditions to interact and evolve.

At the epistemological level, these developments showed that the Islamic scientific tradition was not built upon a single source of knowledge. Religious knowledge rooted in revelation and Islamic intellectual tradition developed alongside the use of reason, logical reasoning, observation, experience, and empirical investigation of natural phenomena. This integrative character can be further understood through the development of Islamic epistemology, later known through the bayani, burhani, and 'irfani approaches. Bayani places religious texts and revelation authority as crucial foundations for obtaining knowledge, burhani emphasizes rational argumentation and empirical proof, while 'irfani provides space for spiritual experience and inner depth (Hendrizal et al., 2024) .

From this perspective, the legacy of Bayt al-Hikmah holds broader significance than a mere romanticization of past Islamic intellectual glory. What remains relevant for re-examination is not only Muslim scholars' success in expanding various branches of science, but also how the Islamic scientific tradition treated knowledge through openness to diverse sources, the application of reason and research, and the provision of a value orientation toward developed knowledge. Encounters with various scientific traditions did not diminish Islamic scientific identity; instead, they became part of the selection, critique, development, and reconstruction of knowledge within the framework of Islamic civilization. Thus, openness to knowledge can go hand in hand with strengthening scientific identity as long as knowledge is not passively swallowed, but critically tested, developed, and directed toward meaningful goals for human life and civilization.

Scientific Transformation in the Modern Era and AI

Scientific advancement in the modern era brought fundamental changes to how humans acquire, construct, and validate knowledge. While classical traditions relied heavily on rationality, argumentation, and observational insights, modern science established scientific methods, systematic observation, experimentation, and empirical proof as prerequisites for

reliable knowledge. This shift gained momentum during the Scientific Revolution of the 16th and 17th centuries, laying the foundation for modern science. However, this transformation was not a complete break from past traditions; modern science maintained continuity with Greek, Arab-Islamic, Chinese, and other scientific legacies. Modernity is thus best understood as an epistemological transformation—a shift in how knowledge is acquired, verified, and justified through the adaptation and reconfiguration of pre-existing intellectual traditions (SALĞAR, 2023).

A defining feature of modern science is the central role of methodology in determining knowledge validity. Claims are no longer accepted solely because they stem from tradition or authority; they require empirical evidence, standardized research procedures, and verifiable arguments. Method thus serves not only as a means to acquire knowledge, but as a criterion for determining validity. While this made science highly systematic, scientific progress does not always occur via simple linear accumulation. Thomas Kuhn demonstrated that science undergoes paradigm shifts when existing frameworks can no longer explain accumulated anomalies. This highlights that scientific evolution involves structural changes in how humans understand, explain, and validate knowledge (Amelia et al., 2024).

Conversely, modern science also drove intense disciplinary specialization, with each field establishing its own distinct research objects, methods, and terminology. While specialization enables deep inquiry, it risks alienating fields from one another if disciplines develop isolated frameworks and standards. In contemporary Islamic epistemology, this dynamic is often linked to scientific fragmentation and the separation between fact and value, science and religion, or knowledge and meaning. The issue is not specialization itself, but the potential loss of integration across forms of knowledge. Critiques of scientific fragmentation do not reject modern science, but emphasize the need for interdisciplinary connection so that knowledge yields not only technical capacity, but remains grounded in human values, meaning, and responsibility (Aini & Dewi, 2025).

This transformation has entered a new phase with the rise of digital technology and Artificial Intelligence (AI). Previously, technology served primarily to help humans search, store, and process information. AI marks a more profound shift, as computational systems can now generate text, analyze complex datasets, translate languages, make predictions, and respond to inquiries. Technology's role has expanded from an access tool to an active participant in knowledge production and delivery, providing outputs humans use to understand complex issues. Consequently, AI introduces a new epistemological reality by reshaping human-technology-knowledge relationships. The core issue extends beyond how humans use AI to retrieve information to how AI-generated outputs are positioned, evaluated, and justified as knowledge.

This shift introduces novel questions regarding epistemic authority. When an individual receives an AI-generated answer, the issue is not merely the speed of delivery, but identifying the grounds for trusting that answer. (Hauswald, 2025) uses the term "artificial epistemic authorities" to describe AI systems performing roles historically reserved for human experts as primary knowledge sources. AI does not automatically possess epistemic authority, but it functions as such when users accept its outputs uncritically. This is problematic because AI outputs derive from data patterns and probabilistic computations that users cannot easily inspect or interpret. Thus, AI shifts authority concerns from *who* holds knowledge to *how* an output gains trust and *who* bears responsibility for its validation. Human evaluation remains indispensable in determining whether an AI output should be accepted, applied, or subjected to further verification.

These issues of authority are closely linked to shifting concepts of knowledge validity in

algorithmic environments. (Shin, 2026) introduces the concept of "algorithmic truth" to explain how automated systems alter how information is produced, verified, and circulated. Because AI outputs rely on statistical probabilities and data patterns, they do not reflect human reasoning that accounts for context, lived experience, and nuanced meaning. Fluency in generating responses does not guarantee truth. Validating AI outputs still requires assessing underlying sources, context, logical consistency, and empirical evidence. Epistemological challenges in the AI era thus demand evaluating not just AI's generative capacities, but how humans verify whether its outputs represent valid knowledge.

In educational settings, these epistemological shifts are crucial as AI becomes directly embedded in learning processes. AI can assist students in accessing and synthesizing information rapidly, but this convenience can alter interactions between students, teachers, and knowledge. Research by (Jose et al., 2025) shows that generative AI in learning spaces impacts these interaction dynamics. When AI outputs are accepted without critical appraisal, students risk relying on AI as an absolute source, bypassing personal inquiry, reasoning, and judgment. The challenge moves beyond technology integration to avoiding a shift where learners revert from active knowledge-builders to passive consumers of automated outputs. Educational AI adoption must keep human learners centered as evaluators, verifiers, interpreters, and decision-makers.

In summary, the transition from modern science to the AI era reflects changing dynamics across sources, methods, validity, and authority of knowledge. Modern science established scientific method and empirical proof as core criteria, though intense specialization introduced risks of fragmentation. AI advances this transformation further, as algorithmic systems generate and deliver content that informs human understanding. This generates new questions regarding validity and authority, as AI outputs can gain unexamined trust. Consequently, primary epistemological challenges in the AI era involve maintaining critical oversight, verifying sources, understanding context, and guiding how knowledge is applied. These considerations underscore the relevance of scientific integration in Islamic education, particularly in connecting sources of knowledge, methods, validation processes, and human authority with AI advancements.

Relevance of Epistemological Transformation for Scientific Integration in Islamic Education

The epistemological transformation spanning classical eras, Islamic scientific developments, modernity, and AI shows that scientific evolution involves structural shifts in sources, methods, validity, and authority of knowledge. These changes carry direct implications for Islamic education. As AI participates in generating and delivering information, Islamic education must move beyond teaching technical skills to build an epistemological framework where learners understand where knowledge originates, how its truth is evaluated, who holds the authority to assess it, and to what purpose it is applied. Scientific integration is essential here, providing a framework to connect revelation, rationality, empirical experience, technology, and ethical values harmoniously. Research by (Haida Rahma et al., 2025) emphasizes connecting revelation, reason, empirical reality, and ethics so Islamic education avoids binary divisions between religious and general sciences.

In this context, scientific integration does not mean merging all disciplines into a single subject or erasing distinct disciplinary boundaries. Rather, integration is best understood as establishing complementary relationships among fields based on their distinct objects, methods, and aims. Religious sciences offer foundational values, spiritual meaning, and ethical guidance, while social sciences, natural sciences, humanities, and technology explain empirical reality through specialized methodologies. Thus, integration counters scientific fragmentation while preserving disciplinary strengths. This aligns with M. Amin Abdullah's integrative-interconnective paradigm, which places diverse academic fields in dialogic relationships so religious and secular sciences are not viewed as isolated domains (Munis et al., 2026).

The relevance of scientific integration becomes evident when Islamic education engages with AI outputs derived from varied sources and disciplines. AI-generated information cannot be evaluated solely on linguistic fluency or volume; it must be examined through an epistemological lens accounting for sources, arguments, empirical evidence, context, and moral values. In Islamic epistemology, the triad of *bayani*, *burhani*, and *'irfani* provides an effective framework for this evaluation. *Bayani* focuses on textual sources and religious interpretation; *burhani* stresses rational argument, empirical proof, and observable facts; and *'irfani* incorporates inner reflection and spiritual dimensions (Ulviana, 2024). These three approaches are complementary rather than mutually exclusive. Integrative epistemology in Islamic education enables students to ask not only whether information is available, but whether it is grounded in reliable evidence, contextually appropriate, and ethically sound.

These epistemological insights can be applied directly to curriculum design and pedagogy. Islamic education curricula should connect Islamic studies with social sciences, natural sciences, humanities, technology, and contemporary issues. This integration can be realized through learning activities that encourage students to analyze topics through multiple perspectives. For example, jurisprudence (*fiqh*) can be studied alongside technological innovation and social change; Islamic theology (*aqidah*) and ethics (*akhlaq*) can frame discussions on AI accountability and digital ethics; and Qur'anic and Hadith studies can be integrated with digital literacy, source criticism, and information verification. Through this approach, scientific integration transitions from a philosophical concept into practical student capabilities: evaluating knowledge sources, using appropriate methods, verifying information validity, and applying ethical reflection to real-world issues.

Epistemological transformations also require a shift in the teacher's role. As AI delivers information and answers rapidly, the teacher's role must evolve from an information provider to a mentor guiding interpretation, verification, and meaningful learning. Teachers assist students in tracing information sources, evaluating AI outputs for accuracy and context, constructing arguments, comparing perspectives, and assessing moral implications. Teachers do not compete with AI in information speed; instead, they fulfill roles that cannot be delegated to algorithms: providing context, moral reasoning, intellectual mentorship, and character development. AI is properly positioned as an instructional aid, while primary epistemic and pedagogical responsibilities remain with human educators (Azizah et al., 2026).

Beyond curriculum and teaching roles, scientific integration in the AI era demands strengthening digital ethics as part of epistemic responsibility. Knowledge concerns not only truth claims, but how information is acquired, applied, shared, and justified. Students must recognize that AI usage involves ethical responsibilities, including academic integrity, proper attribution, data privacy, responsible information sharing, and awareness of algorithmic bias. In Islamic education, digital ethics should be paired with critical thinking, ensuring AI literacy produces responsible individuals guided by religious and human values alongside technical proficiency.

Thus, the relevance of epistemological transformation for Islamic education lies not in choosing whether to accept or reject AI, but in developing a framework to guide its application. Scientific integration must link revelation, reason, empirical experience, technology, and ethical values without eroding the unique contributions of each source or discipline. While AI enhances human capacities to access, process, and generate information, its outputs require human verification, interpretation, and ethical judgment. Scientific integration serves as a framework ensuring technological advancement remains embedded in critical, reflective, and value-oriented educational practices.

Ultimately, the primary challenge for Islamic education in the AI era is preserving the

human learner as an active subject in acquiring, evaluating, and applying knowledge. Islamic education must cultivate learners who utilize technology effectively while rigorously verifying validity, constructing arguments, understanding context, reflecting on values, and taking responsibility for knowledge application. Within this framework, scientific integration aligns technological progress with the ultimate purpose of Islamic education: developing knowledgeable, critical, ethical, and responsible individuals before God, society, and the environment.

Conclusion (خاتمة)

This study demonstrates that the epistemological transformation of knowledge from ancient and classical traditions through Bayt al-Hikmah and modern science to the AI era involves changes in the sources, methods, validity, and authority of knowledge. Bayt al-Hikmah illustrates that openness to diverse intellectual traditions can occur through translation, dialogue, critique, and synthesis within an Islamic value framework. Modern science reinforced scientific methods, observation, experimentation, and empirical proof as standards for validation, though intense specialization introduced risks of disciplinary fragmentation. In the AI era, these dynamics evolve further as algorithmic systems actively generate and deliver content, introducing challenges regarding validity and authority when automated outputs gain unexamined trust.

These findings indicate that the primary relevance of epistemological transformation for Islamic education lies in building a scientific integration framework that goes beyond combining religious and secular subjects to critically connect sources, methods, validation processes, and authority structures. The integrative-interconnective paradigm offers a framework to unite revelation, reason, empirical evidence, technology, and spiritual-ethical dimensions. In the context of AI, this framework can be implemented through curricula bridging Islamic studies with sciences, humanities, and technology; redefining teachers as mentors in knowledge verification and interpretation; and cultivating digital ethics that emphasize academic integrity, source evaluation, data privacy, awareness of algorithmic bias, and responsible communication. Conceptually, this study highlights that scientific integration in the AI era must be addressed as an epistemological and educational imperative rather than a purely technological issue.

This study has limitations, as its reliance on a library research design means analysis was based on existing literature without directly testing these conceptual frameworks in operational educational settings. Future research should pursue empirical studies using observation, interviews, or case studies within Islamic educational institutions to evaluate how students and teachers verify, apply, and assess AI outputs during instruction. Further research could also examine practical implementations of the integrative-interconnective paradigm across curriculum development, teacher competency frameworks, and AI literacy programs in diverse Islamic educational contexts.

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