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Islamic Epistemology and Digital Scientific Literacy in Primary Education: A Conceptual Study

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Abstract

The development of digital technology has transformed learning patterns in primary education, yet this transformation has not been fully accompanied by the strengthening of students' scientific literacy, critical thinking, and digital ethics. This study aims to examine the relationship between Islamic epistemology and digital scientific literacy and to formulate an integrative educational framework for primary education. The study employed a qualitative conceptual approach through library research, reviewing scholarly literature on Islamic epistemology, digital competence, digital learning, scientific literacy, and primary education. The literature was examined thematically by identifying, comparing, and synthesizing concepts related to knowledge formation, scientific inquiry, digital competence, critical thinking, ethics, and character formation. The conceptual framework was developed through the synthesis of these themes and the identification of conceptual linkages between Islamic epistemological principles and the dimensions of digital scientific literacy. The findings indicate that existing discussions of digital learning tend to emphasize technological access, digital skills, and the instrumental use of digital tools, while comparatively less attention is given to epistemological reflection, scientific verification, ethical responsibility, and value formation. The synthesis further demonstrates that Islamic epistemology, which integrates revelation, reason, ethics, and empirical experience, can provide a holistic philosophical foundation for strengthening digital scientific literacy. The novelty of this study lies in the formulation of an integrative educational framework that connects digital competence, scientific literacy, critical thinking, digital ethics, and character formation through an Islamic epistemological perspective in primary education. This study contributes to Islamic Education, Educational Technology, and Science Education by offering an interdisciplinary and value-oriented framework for developing holistic digital learning in primary education.

Keywords: Islamic Epistemology, Digital Literacy, Primary Education

Introduction

The development of digital technology over the last two decades has brought significant changes to the global educational paradigm (Yaman et al. 2024). Digital transformation has reshaped the ways individuals access information, influencing how people think, learn, communicate, and construct knowledge (Litina and Rubene 2024). In the context of primary educa-tion, these developments require students to possess scientific reasoning skills as well as the ability to utilize digital technology critically, creatively, and ethically (Karadag et al. 2024). Therefore, scientific literacy and digital competence have become two essential

competencies of twenty-first century education that continue to receive considerable attention in international educational policies (Silva, Rodrigues, and Vicente 2024). Organizations such as *UNESCO* and *Organisation for Economic Co-operation and Development* have positioned digital literacy and scientific lite-racy as fundamental foundations for developing human resources that are adaptive to social and technological changes (Pinar and Meral 2024).

In the global context, scientific literacy is understood as the ability to use scientific kno-wledge to make rational decisions in everyday life (Rosa, García, and Mercedes 2023). Digital competence has also evolved from merely technical skills into the ability to think critically and ethically about digital information, as well as the capacity to generate new knowledge through technology (Niklas et al. 2022). However, the rapid development of digital technology has also created serious challenges for education, particularly in primary education (Evdokimov et al. 2025). Today's students live within a fast, open, and unlimited flow of digital information. The pheno-mena of information overload, the spread of disinformation, instant culture, and the low ability to verify information have become increasingly complex issues (Pimentel 2025). Primary sch-ool students are introduced to digital technology from an early age, yet many still lack adequate scientific reasoning skills and digital ethics to critically filter the information they receive (Ross et al. 2025). As a result, the use of digital technology tends to be dominated by enterta-inment oriented activities rather than the development of academic character and reflective learning (Sheriff and Sevukan 2023). In Indonesia, these challenges are reflected in the low level of students' scientific literacy achievement in various international assessments. Results from the *Programme for Internati-onal Student Assessment* (PISA) indicate that Indonesian students' scientific literacy remains below the average of OECD countries (Bozzo et al. 2025). Students' limited ability to analyze scientific problems, understand cause-and-effect relationships, and apply scientific evidence in decision-making demonstrates that science education has not yet optimally developed scientific ways of thinking (Cruz and Moreno 2026). On the other hand, the acceleration of educational digitalization in the post-pandemic era has also revealed that both students and teachers conti-nue to face various limitations in digital competence, particularly in pedagogical and ethical di-mensions (Rovira-collado and Martínez-carratalá 2026).

This phenomenon indicates a gap between the development of digital technology and stu-dents' scientific literacy in primary education (Mardatillah et al. 2025). Educational practices tend to focus more on technological mastery as a tool rather than integrating epistemological dimensions into the learning process (Tomassi, Falegnami, and Romano 2025). Consequently, digital technology is often understood instrumentally without being accompanied by the strengthening of values, et-hics, and deeper scientific orientation(Akif and Tatar 2021). In this context, primary education requires an integrative approach capable of connecting digital learning with epistemological foundations that shape students' ways of thinking holistically (Ostrovska et al. 2023). One rel-evant approach to be developed is the perspective of Islamic epistemology, which views know-ledge as being acquired through the integration of revelation, reason, empirical experience, and spiritual intuition (Shukshina et al. 2021). This perspective provides a philosophical founda-tion that the development of science and technology should be directed toward the formation of individuals who are knowledgeable, ethical, and socially responsible (Torous et al. 2025).

From the perspective of Islamic epistemology, scientific activity is not merely aimed at acquiring knowledge, but also at developing awareness of divine values, humanity, and social responsibility (Galan et al. 2021). Within the Islamic framework, scientific literacy does not stop at the ability to understand scientific facts; it also includes the ability to apply knowledge wisely and ethically (Liamruk et al. 2025). Likewise, digital literacy is not only understood as

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the ability to use technology, but also as the capacity to utilize technology for social benefit while avoiding the misuse of digital information (Torrijos-muelas, González-Víllora, and Bodoque-Osma 2024). Therefore, the integration of Islamic epistemology can serve as a foundation for developing a model of digital scientific literacy that is not only intellectually grounded, but also ethically and spiritually mat-ure (Listyaningrum, Retnawati, and Ibda 2025). Although studies on digital literacy and scientific literacy have grown extensively, most previous research has tended to separate technological aspects, science education, and Islamic philosophical dimensions (Dringó-horváth, Rajki, and Nagy 2025). Many studies focus on the impact of digital technology on learning outcomes, the effectiveness of learning media, or the development of twenty-first century skills, yet few have specifically examined the relationship between digital scientific literacy and Islamic epistemology within the context of primary education (Mercedes González-Sanmamed, Rebollo-Quintela, and Rodríguez-Machado 2023).

The limitations of previous studies indicate the existence of an important research gap that requires deeper investigation. First, there remains limited research integrating scientific lit-eracy and digital competence within a comprehensive conceptual framework. Second, studies on Islamic epistemology in primary education are still predominantly normative and have not been directed toward the development of digital-scientific learning models. Third, research on digital education from an Islamic perspective generally focuses on character education or me-dia ethics rather than on the epistemological construction of digital scientific literacy. There-fore, a new approach is needed to bridge the relationship between digital technology, scientific literacy, and Islamic epistemology within an integrative educational framework.

This study is significant in supporting the transformation of Islamic education in the digital era. The integration of Islamic epistemology with digital scientific literacy can serve as an effort to reconstruct the paradigm of Islamic education so that it becomes more relevant to global challenges without losing its philosophical identity and Islamic values. Based on this background, the present study aims to examine and formulate an integrative educational frame-work that connects Islamic epistemology with digital scientific literacy in primary education. This research seeks to develop a conceptual model that positions digital technology, scientific lite-racy, and Islamic epistemological values as an interconnected unity within the educational pro-cess. Therefore, this study is expected to contribute theoretically to the development of Islamic Education and digital education studies, while also providing practical contributions to the development of learning models in primary education that are more holistic, integrative, and relevant to the challenges of the twenty-first century digital era.

Method

This study employed a qualitative method using library research and a conceptual-philosophical approach. This approach was selected because the study focuses on the exploration, interpretation, and construction of a conceptual framework concerning the relationship between Islamic epistemology and digital scientific literacy in primary education. A qualitative approach was considered relevant for gaining an in-depth understanding of epistemological paradigms, philosophical values, and the conceptual integration of Islamic education, scientific literacy, and digital competence within the context of contemporary education (Mercedes González-Sanmamed et al. 2023) In addition, the conceptual approach was utilized to develop an integrative educational framework oriented toward the construction of a theoretical model in primary education.

The primary objects of this study are the concepts of Islamic epistemology, digital scientific literacy, and primary education as the focus of an integrative inquiry. The research subjects consist of academic literature relevant to the research topic, including reputable international journal articles, scholarly books, previous studies, documents from international educational institutions, and works of Islamic education scholars. The literature was selected using a purposive sampling technique by considering thematic relevance, source credibility, publication recency, and contributions to the development of the study's theoretical framework (Ponomariovienė and Staskuviene 2022). The criteria for the selected literature included: (1) discussions on Islamic epistemology, Islamic education, or the integration of knowledge; (2) studies addressing scientific literacy, digital competence, or twenty-first century education; (3) publications in reputable national or international journals; and (4) relevance to the context of primary education and digital educational transformation.

The study was conducted through several systematic stages. The first stage involved identifying the research problem through an exploration of digital education phenomena, the development of scientific literacy, and epistemological challenges in primary education. The second stage consisted of collecting various primary and secondary literature sources relevant to the research topic. The subsequent stage involved conceptual analysis of theories, previous research findings, and expert perspectives to identify the substantive relationship between Islamic epistemology and the development of digital scientific literacy. This was followed by a process of theoretical synthesis aimed at formulating an integrative educational framework to serve as a conceptual foundation for developing primary education learning in the digital era. The final stage involved drawing conclusions and constructing the study's conceptual formulation based on the results of data analysis and interpretation (Rosa et al. 2023).

The primary instrument of this study was the researcher, who played a central role in determining the research focus, selecting data sources, interpreting findings, and critically and reflectively analyzing the data (Galan et al. 2021). The research data consisted of primary and secondary sources. Primary data were obtained from national and international journal articles, books on Islamic epistemology, and educational institutional documents discussing scientific literacy and digital competence. Secondary data were collected from supporting books, conference proceedings, research reports, and other academic sources relevant to the research topic. Data collection techniques involved documentation study and literature review. The researcher conducted literature searches through academic databases such as Scopus, Google Scholar, and ERIC to obtain credible and relevant scholarly sources. The collected data were then classified based on themes and research focuses to facilitate the conceptual analysis process.

The data analysis techniques employed in this study were content analysis and conceptual analysis. Content analysis was used to identify, understand, and interpret key concepts related to Islamic epistemology, scientific literacy, and digital competence in primary education. Meanwhile, conceptual analysis was utilized to construct theoretical relationships among concepts in order to formulate an integrative educational framework (Rovira-collado and Martínez-carratalá 2026) The analysis process was conducted through several stages: (1) data reduction, by selecting literature relevant to the research focus; (2) data display, by systematically organizing concepts and findings from previous studies; (3) data interpretation, by analyzing the relationship between Islamic epistemology and digital scientific literacy; and (4) conclusion drawing and formulation of the integrative conceptual framework. To ensure data validity, the study employed source triangulation through comparisons of various literature sources and previous research findings related to the research theme.

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Results

The Crisis of Digital Scientific Literacy in Primary Education

The development of digital technology has significantly transformed students' learning patterns in primary education. Digital environments have become the primary space where students obtain information, understand scientific phenomena, and build learning experiences. However, the results of the literature analysis indicate that the advancement of digital technology has not been fully accompanied by the strengthening of students' scientific literacy. Many students have broad access to digital technology but still lack the ability to evaluate the validity of information, understand scientific processes, and utilize knowledge in a reflective and ethical manner. The number of documents analyzed in this study is presented as follows:

Table 1. Number of Analyzed Documents

No.	Research Focus	Number of Literatur Sources	Percentage
1	Low ability to verify digital information	12	24%
2	Dominance of consumptive technology use	10	20%
3	Weak scientific critical thinking skills	9	18%
4	Limited integration of digital ethics in learning	8	16%
5	Absence of epistemological foundations in digital learning	6	12%
6	Low level of students' reflective ability	5	10%
	Total	50	100%

Previous studies indicate that the use of digital technology in primary schools remains predominantly oriented toward technical and instrumental aspects. Digital learning is more frequently focused on the use of applications, visual media, and rapid access to information rather than on the development of scientific and reflective thinking skills. This condition has led students to become more accustomed to being consumers of information rather than critical evaluators of information. This phenomenon reflects a crisis of digital scientific literacy, in which students are digitally active but weak in scientific, analytical, and epistemological competencies. The findings are further presented in the following table:

Table 2. Problems of Scientific Literacy in Primary Education

No.	Problem Aspect	Main Findings
1	Technology use	Oriented toward technical and instrumental aspects
2	Scientific literacy	Weak in scientific analysis and verification
3	Learning patterns	Predominantly consumptive and instant-oriented
4	Ethical dimension	Low moral reflection in digital usage
5	Knowledge construction	Not yet grounded in epistemological and critical approaches

The table above demonstrates that digital transformation in primary education has not yet fully addressed the dimension of knowledge construction. Digital education is still predominantly understood as merely the modernization of learning technology rather than as a process of developing students' scientific and intellectual awareness. From a broader perspective, this condition reflects the dominance of a technocratic educational paradigm that positions technology as the primary goal of education, while philosophical and moral dimensions tend to be marginalized. These findings indicate that digital education requires a more integrative approach to ensure that technological advancement does not lead to the degradation of students' scientific thinking abilities. In this context, a philosophical foundation is needed to establish a balanced connection between technology, science, and human values.

Islamic Epistemologi as an Integrative Foundation

The results of the analysis indicate that Islamic epistemology possesses an integrative character that is highly relevant to the development of digital scientific literacy in primary education. Within the Islamic intellectual tradition, knowledge is understood as a unity of revelation, reason, empirical experience, and ethical-spiritual dimensions. This perspective differs from the modern educational paradigm, which tends to separate technological advancement from the moral and spiritual development of students. Islamic epistemology views scientific activity not merely as a process of acquiring information, but also as a process of seeking meaning, wisdom, and social responsibility. Therefore, scientific literacy from an Islamic perspective is not solely oriented toward mastering scientific concepts, but also toward the ability to apply knowledge ethically and beneficially for human life. In the digital context, technological competence is not merely understood as the technical ability to operate digital devices, but also includes moral awareness in managing information and using technology responsibly.

Table 3. Characteristics of Islamic Epistemology in Digital Scientific Literacy

No.	Dimensions of Islamic Epistemology	Implications for Digital Scientific Literacy
1	Integration of revelation and reason	More holistic learning
2	Ethics-based knowledge	More responsible use of technology
3	Reflective approach	Strengthening critical and scientific thinking
4	Orientation toward public benefit	Technology directed toward social benefit
5	Spiritual awareness	Strengthening students' character and morality

The findings of this study demonstrate that the integration of Islamic epistemology can serve as a solution to the crisis of digital education that has become excessively pragmatic and mechanistic. Education grounded in Islamic epistemology enables students to develop scien-tific thinking skills while simultaneously fostering spiritual awareness and digital ethics. This approach is essential because technological advancement without a moral foundation has the potential to generate intellectual crises and character degradation among students. The discussion further reveals that Islamic epistemology holds strong relevance in addressing the challenges of contemporary digital education. This perspective offers an alternative approach

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to modern educational models that tend to emphasize technical aspects rather than the develop-ment of students' epistemological awareness.

Reconstruction of Digital Scientific Literacy in Primary Education

Based on the results of the conceptual analysis, this study finds that the development of digital scientific literacy in primary education needs to be reconstructed through an integrative educational approach. This reconstruction is carried out by connecting three main dimensions: digital competence, scientific literacy, and Islamic epistemology as a philosophical foundation of education. Within this framework, digital competence is not only directed toward the ability to access technology, but also toward the ability to critically evaluate information, understand the validity of scientific sources, and use digital media ethically. Scientific literacy is positioned as the ability to understand scientific phenomena through observation, logical reasoning, and evidence-based decision making. Meanwhile, Islamic epistemology functions as a value foundation that integrates rational, empirical, moral, and spiritual dimensions within the learning process. The findings of this study indicate that the integration of these three dimensions can produce a more holistic educational model compared to conventional digital education approaches. Students are not merely developed as users of technology, but also as individuals who possess scientific awareness, ethical responsibility, and reflective abilities in responding to the rapid development of digital information. A clearer illustration of this framework can be seen in the following figure:

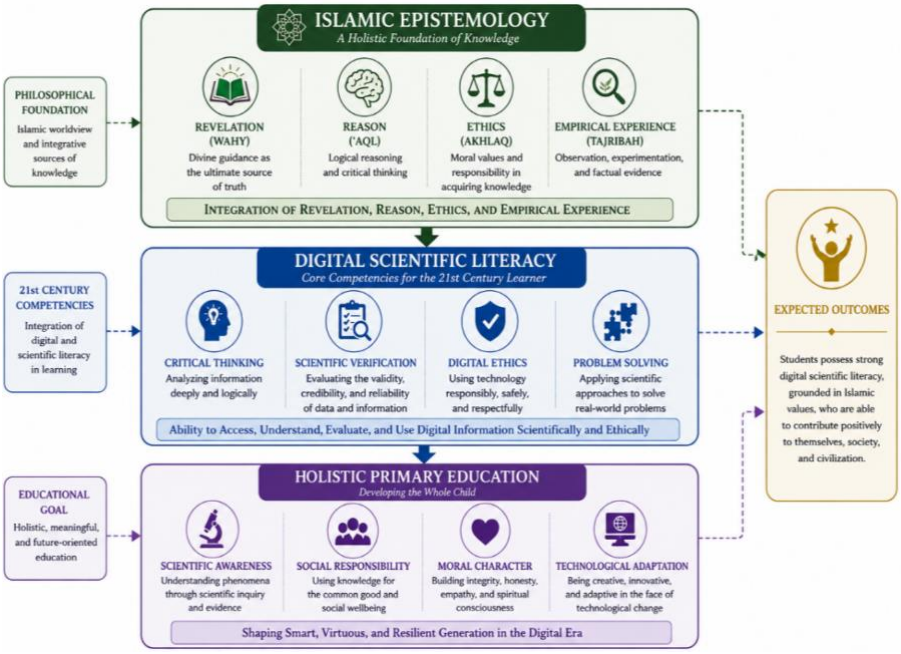


Figure 1. Integrative Framework of Digital Scientific Literacy Based on Islamic Epistemology

The discussion above demonstrates that this study produces a novelty in the form of an integrative educational framework based on Islamic epistemology for the development of digital scientific literacy in primary education. The novelty of this research lies in the integration of Islamic epistemological dimensions with digital competence and scientific literacy, which have previously tended to be examined separately. Previous studies have primarily focused on the effectiveness of educational technology or the cognitive strengthening of scientific literacy, whereas this study offers a philosophical-integrative approach that connects technology, science, ethics, and spirituality within a unified educational framework. The implications of this research indicate that the development of primary

education in the digital era should not merely focus on technological mastery, but must also strengthen students' epistemological and moral foundations. Therefore, educational institutions need to develop learning models that integrate digital competence, scientific thinking skills, and ethical-spiritual values within the educational process.

Discussion

The findings of this study reveal that the rapid development of digital technology in primary education has not been fully accompanied by the strengthening of students' digital scientific literacy. The analysis of 50 literature sources identified several major problems, with the most dominant being students' low ability to verify digital information (24%), followed by the dominance of consumptive technology use (20%), weak scientific critical thinking skills (18%), limited integration of digital ethics in learning (16%), the absence of strong epistemological foundations in digital learning (12%), and low levels of students' reflective ability (10%). These findings indicate that the main challenge is not merely students' access to digital technology, but their ability to critically evaluate, interpret, and use the information obtained through digital environments. Students may have extensive access to digital devices and information sources, yet this access does not automatically develop their scientific reasoning or their ability to distinguish valid scientific information from unreliable information. Thus, digital access and technological competence should not be equated with the achievement of digital scientific literacy (Niklas et al. 2022).

The findings further indicate that the use of technology in primary education remains largely oriented toward technical and instrumental functions. Digital learning tends to emphasize the use of applications, visual media, and rapid access to information rather than the development of scientific, analytical, and reflective thinking (Tomassi et al. 2025). As a result, students are more frequently positioned as consumers of information than as critical evaluators of information. This condition demonstrates a gap between digital competence and scientific literacy. Although students may be able to operate digital devices and access information efficiently, they may not necessarily possess the ability to examine the credibility of sources, analyze evidence, understand scientific processes, or construct knowledge through critical inquiry. This situation suggests the persistence of a technocratic paradigm in digital education, in which technology is often regarded as the primary indicator of educational modernization. Consequently, digital transformation risks becoming merely a process of technological modernization rather than a transformation of how students understand, evaluate, and construct knowledge. The findings therefore suggest that digital education requires a broader foundation that connects technology with scientific reasoning, ethical awareness, and intellectual development (Liamruk et al. 2025).

In this context, Islamic epistemology emerges from the findings as a relevant integrative foundation for addressing the challenges of digital scientific literacy in primary education. Islamic epistemology conceptualizes knowledge as an integrated relationship between revelation, reason, empirical experience, and ethical-spiritual dimensions. From this perspective, scientific activity is not limited to the acquisition of factual information or the mastery of scientific concepts, but also involves the pursuit of meaning, wisdom, responsibility, and benefit for human life. This perspective provides an important foundation for digital learning because technological competence should involve not only the ability to operate digital devices but also the moral awareness required to manage information and use technology responsibly. The integration of Islamic epistemology therefore provides an alternative to educational approaches that tend to separate technological development from

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students' moral and spiritual development. It positions knowledge and technology within a broader framework of responsibility, ensuring that scientific and digital capabilities contribute positively to individual and social life (Cruz and Moreno 2026).

The study also identifies several dimensions of Islamic epistemology that are particularly relevant to the development of digital scientific literacy. The integration of revelation and reason can encourage a more holistic learning process by connecting rational inquiry with broader sources of meaning. The ethics-based conception of knowledge can strengthen students' responsibility in using technology and digital information. A reflective approach can support the development of critical and scientific thinking by encouraging students to question, evaluate, and reconsider the information they encounter. The orientation toward public benefit can direct the use of technology toward socially beneficial purposes, while spiritual awareness can contribute to the development of students' character and morality. These dimensions demonstrate that Islamic epistemology can function not merely as an additional religious component within digital learning, but as a philosophical foundation that connects intellectual, empirical, ethical, and spiritual dimensions. Such an approach is particularly important in the digital era, when students are exposed to an enormous volume of information and require not only cognitive skills but also ethical and reflective capacities to determine how knowledge should be acquired and used (Yaman et al. 2024).

Based on these findings, the development of digital scientific literacy in primary education needs to be reconstructed through the integration of three interconnected dimensions: digital competence, scientific literacy, and Islamic epistemology. Digital competence enables students to access, navigate, and use digital technologies, while scientific literacy enables them to understand scientific phenomena through observation, logical reasoning, evidence-based analysis, and informed decision-making. Islamic epistemology provides the philosophical and value-based foundation that connects these competencies with ethical, moral, and spiritual considerations. The integration of these three dimensions offers a more holistic framework than conventional digital education approaches. Students are therefore not developed merely as competent users of technology, but as individuals capable of evaluating information critically, understanding scientific evidence, reflecting on the knowledge they acquire, and using technology responsibly. This integrative framework addresses the weaknesses identified in the literature analysis by moving digital education beyond technical proficiency toward a model of learning that emphasizes scientific awareness, ethical responsibility, and reflective capacity (Rosa et al. 2023).

The main contribution and novelty of this study lie in the integration of Islamic epistemological dimensions with digital competence and scientific literacy within the context of primary education. Previous approaches have tended to examine educational technology, scientific literacy, and ethical or philosophical dimensions separately, whereas this study brings these dimensions together within a unified educational framework. The findings consequently suggest that digital transformation in primary education should not be understood simply as the adoption of new technologies, but as an opportunity to reconstruct the way students acquire, evaluate, construct, and apply knowledge. The proposed framework positions Islamic epistemology as a philosophical foundation for balancing technological advancement with scientific reasoning, ethical responsibility, and spiritual awareness. Therefore, educational institutions should develop learning models that integrate digital competence, scientific thinking, information verification, ethical technology use, and reflective learning. Such an approach can help ensure that technological advancement strengthens rather than diminishes students' scientific and intellectual development, while simultaneously supporting the formation of responsible, reflective, and morally grounded learners.

Conclusion

The development of digital technology in primary education has not been fully accompanied by the holistic strengthening of students' scientific literacy. Digital transformation in learning tends to focus more on technical and instrumental aspects rather than on the development of critical thinking, scientific verification, epistemological reflection, and digital ethics. This condition has resulted in students having broad access to digital technology while still lacking the ability to use information critically, scientifically, and responsibly. Based on the results of the conceptual analysis, this study finds that Islamic epistemology holds strong relevance as an integrative foundation for the development of digital scientific literacy in primary education, as it views knowledge as an integration of revelation, reason, experience, and ethical-spiritual values. This perspective enables education to be oriented not only toward the mastery of science and technology, but also toward the development of students' moral awareness, social responsibility, and spiritual reflection.

The novelty of this study lies in the formulation of an integrative educational framework based on Islamic epistemology that connects digital competence, scientific literacy, and holistic primary education within a single conceptual model. This framework positions critical thinking, scientific verification, digital ethics, and problem-solving as inseparable components of students' moral character formation and social awareness. The study contributes theoretically to the development of Islamic Education, Educational Technology, and Science Education through an interdisciplinary approach that integrates technology, science, and spirituality in contemporary education. Furthermore, this research emphasizes that the development of primary education in the digital era requires learning models that not only prioritize technological competence, but also strengthen epistemological and ethical foundations so that students are able to become critical, responsible, adaptive, and socially oriented individuals amid the increasing complexity of digital technological development.

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