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From Classical Epistemology to Digital Scholarship: A Paradigm Shift in Contemporary Scientific Construction

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Abstract

This study analyzes the epistemological shift from the classical paradigm to digital scholarship as a form of contemporary scientific construction. Using a qualitative-descriptive approach based on the analysis of the philosophy of science and critical literature review, this study traces the changes in the concepts of truth, authority, and scientific validity resulting from the digitization of knowledge practices. Classical epistemology, rooted in rationality, empiricism, and objectivity, is now shifting towards an open knowledge system that emphasizes collaboration, transparency, and interdisciplinary connectivity. The results of the analysis show that digital infrastructure, algorithms, and big data form a new regime of truth, in which scientific validity is determined through global network participation, not solely by hierarchical verification by academic institutions. Through a synthesis of the ideas of Kuhn, Foucault, Latour, Gibbons, and Borgman, this study formulates the concept of reflexive digital epistemology, which is a scientific model that is socially and technologically aware, collaborative, open, and ethical. This study emphasizes the importance of a new scientific evaluation paradigm based on openness, epistemic justice, and digital responsibility, while highlighting the risks of algorithmic bias, data coloniality, and access inequality in the evolving practice of global digital science.

INTRODUCTION

The development of science has never been linear. The history of science shows that each period has its own epistemological framework, a particular way of understanding what is referred to as "valid knowledge." In the classical context, from the Enlightenment to the 19th century, science was understood as a systematic human endeavor to discover the laws of nature objectively through rationality and empirical observation. Classical epistemology placed scientists as autonomous subjects seeking universal truths through scientific methods believed to be free from social values and biases. However, entering the 21st century, the scientific landscape has changed radically with the digital revolution. The emergence of big data, open access, and online collaboration has created a new knowledge system that is open, interdisciplinary, and participatory. This shift indicates that science is now produced

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not only in laboratories, but also through social networks and global digital infrastructure.

Criticism of the assumptions of neutrality and objectivity in classical epistemology began to grow stronger in the 20th century. Kuhn, (2021) in The Structure of Scientific Revolutions rejected the positivistic view of cumulative scientific progress. According to him, scientific development occurs through paradigm shifts in intellectual revolutions that change the way scientists understand reality. In line with this, Popper, (2005) emphasized falsification as a criterion of scientific rationality, while (Lakatos, 1970) introduced research programs as a dynamic structure of science. Epistemological criticism was later expanded by Bowden, (2020), who highlighted the relationship between knowledge and power through the concept of episteme. He showed that every knowledge system always contains political and social dimensions that determine the limits of human thinking. Thus, classical epistemology, which appears objective, is actually built on a socio-historical structure that regulates the production and distribution of truth.

Social constructivist views, as proposed by Nelson, (1989), expand on this critique by showing that scientific facts are the result of social negotiations within networks involving humans, technology, and institutions. Science is not a reflection of reality, but rather the result of collective construction that depends on material and social contexts. As digital technology began to dominate scientific practice, this social construction evolved into a new form called digital scholarship. Borgman, (2007); Hooley, (2013); Lemieux, (2017) emphasize that digital scholarship is not just the use of technology in research, but an epistemological transformation that touches on all dimensions of science: how data is collected, research results are disseminated, and scientific credibility is built. In this sense, science becomes more open, collaborative, and driven by the principles of transparency and universal access to knowledge.

The phenomenon of digital scholarship represents what is referred to Atkinson, (1995) as Mode 2 Knowledge Production, namely the production of knowledge in the context of heterogeneous and cross-border social applications. Knowledge is no longer produced in closed institutions (Mode 1), but in open networks involving various actors from academia, industry, society, and algorithms. In this context, an important philosophical question arises: how does classical epistemology, based on objectivity, rationality, and hierarchy, transform into digital epistemology based on collaboration and openness? This paper aims to explore the philosophical roots of this shift and formulate its implications for scientific validity, authority, and truth in the digital age. The approach used is conceptual-philosophical, reviewing the main theories of classical philosophy of science and contemporary literature on open science and digital scholarship.

This literature review serves to map the philosophical and theoretical foundations of the paradigm shift in the construction of science from classical epistemology to digital and collaborative forms of science. The study is based on ten major works in modern philosophy of science and twenty relevant international journal articles. In general, classical epistemology emphasizes rationality, empiricism, and objectivity, while contemporary epistemology, especially in the context of digital scholarship, emphasizes collaboration, openness, and plurality of knowledge. This shift is not merely a methodological transition, but a fundamental transformation in the socio-technological structure that supports science. Thus, the literature shows continuity between classical scientific rationalism and modern social constructivism, which now culminates in networked epistemology.

The roots of classical epistemology can be traced back to Cartesian rationalism and Newtonian empiricism, which place objectivity and observation as the foundation of scientific truth. Popper, (2005) introduced falsification as the basic principle of valid knowledge; while (Lakatos, 1970) through Criticism and the Growth of Knowledge explained the dynamics of science through logically developing research programs. Wilson & Feyerabend, (1978) opposed the rigidity of a single scientific method with his call for "anything goes," emphasizing the importance of epistemological freedom. Although providing a strong foundation for modern science, this approach has been criticized for ignoring the social, historical, and political dimensions of knowledge. These criticisms paved the way for pluralistic views that see scientific truth as a construction that is always context-bound.

Through The Structure of Scientific Revolutions Wilkinson et al., (2016), it is shown that science develops through paradigm shifts, not linear accumulation. Paradigms define what can be considered scientific and valid at a particular time. (Bowden, 2020), with the concept of episteme, adds the dimensions of power and history to epistemology. He asserts that each knowledge regime creates a "regime of truth" shaped by social and political structures. The combination of Kuhn and Foucault's ideas shows that knowledge is both historical and normative, depending on the networks of power and scientific communities that support it. In the digital context, this view helps to understand how algorithms and big data have become new structures that regulate the production and validation of knowledge (algorithmic regime of truth).

Markovsky & Cetina, (2000); Nelson, (1989) shifted the focus of epistemology from rationality to practice. In Science in Action, Latour shows that scientific facts are constructed through networks of relationships between humans, instruments, and texts. His Actor-Network Theory (ANT) views material objects and technologies as having epistemic agency that is as important as that of scientists. Ian Hewitt, (2001) then reinforced the position of moderate constructivism with the concept of interactive realism, which states that scientific reality is formed through interactions between the material world and social practices. In the context of digital scholarship, these two ideas explain how algorithms, platforms, and data infrastructure are not merely tools, but epistemic actors that help shape the meaning of scientific truth.

Atkinson, (1995) introduced Mode 2 Knowledge Production to explain contemporary forms of science that are transdisciplinary, applied, and contextual. Nowotny, Scott, and Atkinson, (1995) emphasized that scientific validity is now measured not only by theoretical truth, but also by social relevance. Meanwhile, Constant & Pickering, (1997) in The Mangle of Practice rejects the subject-object dichotomy and describes science as a dynamic interaction between humans, materiality, and technology. These three approaches form the foundation for a collaborative and application-oriented digital epistemology. In the digital environment, Mode 2 finds its continuation through open science, citizen science, and online collaboration across institutions.

Borgman, (2007); Hooley, (2013); Kitchin, 2014; Lemieux, (2017) show that digital scholarship integrates digital technology throughout the scientific cycle: data collection, analysis, and dissemination. The phenomenon of big data Leonelli, (2014) marks the birth of data-based epistemology, where correlations and statistical patterns often replace theoretical hypotheses. The FAIR principles Wilkinson et al., (2016) and the reproducibility manifesto Munafò et al., (2017) emphasize the importance of transparency and open access as new values of scientific validity. Digital scholarship, thus, is a meeting point between classical rationalism and social constructivism, building an epistemology that is open, reflexive, and collaborative in the global digital space.

METHODS

The unit of analysis in this study is the epistemological construction of science as it has developed from the classical paradigm to digital scholarship. The focus of analysis is not directed at specific individuals or institutions, but rather at the ideas, concepts, and epistemic practices that form the foundation for the production of scientific knowledge. Classical epistemology is understood through key works such as Lakatos, (1970); Popper, (2005); Wilkinson et al., (2016), while digital scholarship is traced through the thoughts of Borgman, (2007); Hooley, (2013); Lemieux, (2017). Thus, the main units of analysis include academic texts, methodological principles, and open policies that shape contemporary scientific practice. This approach allows researchers to identify ontological and axiological shifts from science based on rationality and hierarchy to a digital scientific system that is open, participatory, and collaborative (Aryasutha et al., 2025; Engkizar et al., 2023, 2024, 2025; Jaafar et al., 2025; Putri et al., 2025; Ummah et al., 2025).

This study uses a qualitative-descriptive design with a philosophical approach to science and critical literature review. This design was chosen because the purpose of the study was not to test quantitative hypotheses, but rather to interpret the meaning and direction of epistemological transformation. The philosophy of science approach was used to understand the basic structure of knowledge as described by Kuhn, Popper, and Feyerabend, while critical literature studies referred to the systematic review model as used by Tennant et al., (2016); Vicente-Saez & Martinez-Fuentes, (2018) in analyzing open science. This research is interpretive, with analysis directed at scientific texts and ideas that represent certain paradigms. Through this combination, the research is expected to present a comprehensive picture of the epistemic dynamics from the classical era to the digital era.

The data used in this study consists of two main types, namely primary and secondary data in the form of academic literature. Primary data includes seminal works that form the foundation of classical epistemology, such as The Structure of Scientific Revolutions (Wilkinson et al., 2016), The Logic of Scientific Discovery Popper, (2005), and Against Method. Meanwhile, secondary data includes works that discuss the phenomenon of digital scholarship, such as Scholarship in the Digital Age Borgman, (2007), The Digital Scholar (Weller, 2011), and The Data Revolution (Kitchin, 2014). In addition to books, this study also refers to 20 recent international journal articles discussing big data, open science, altmetrics, and reproducibility. These sources were selected purposively, considering their conceptual relevance, academic credibility, and the recency of the information.

Data collection techniques were carried out through documentary study and content analysis. All references were collected using scientific databases such as JSTOR, Scopus, and Google Scholar, with the keywords “epistemology,” “digital scholarship,” “open science,” and “knowledge construction.” Each source was then selected based on criteria of topic relevance and contribution to the discussion of scientific epistemology. The collected data were organized into thematic categories: i) classical epistemology and falsification, ii) social paradigms of knowledge, and iii) digital scholarship and scientific openness. Furthermore, each category was analyzed to find conceptual relationships between ideas, as suggested by Kitchin, 2014; Lemieux, (2017). This technique allows researchers to trace the continuity and discontinuity between paradigms within a coherent theoretical framework.

Data analysis was conducted using hermeneutic and comparative methods, interpreting key texts within their historical and conceptual contexts. The hermeneutic approach enabled an understanding of the meanings hidden behind philosophical arguments, while comparison helped identify shifts in epistemic structures between the classical and digital eras. Each text was analyzed in three stages: content description, concept interpretation, and thematic synthesis. In the final stage, the results of the interpretation were linked to contemporary issues such as reproducibility Munafò et al., (2017), open data Wilkinson et al., (2016), and altmetrics (Bornmann, 2014). This analysis aims to construct a new epistemological model that reflects the interconnectedness between theory, technology, and the scientific community. Thus, the research results are not only descriptive but also provide a reflective framework for understanding the direction of contemporary science.

RESULT AND DISCUSSION

Literature analysis shows that there has been a significant shift in the way science is constructed. Classical epistemology, rooted in rationalism and empiricism, places truth as the result of logical verification and objective observation (Lakatos, 1970; Popper, 2005). However, entering the digital age, this principle has shifted towards a paradigm of openness, participation, and interconnection. Within the framework of digital scholarship (Bornmann, 2014; Hooley, 2013), the production of knowledge no longer depends on a single institution, but on a globally interconnected scientific network. The results of the analysis show that contemporary epistemology emphasizes collective, data-driven, and reflexive processes in relation to the socio-technological context.

From reading various sources, a common pattern has been found that the classical concept of objectivity is beginning to be replaced by transparency and reproducibility as new criteria for scientific truth (Munafò et al., 2017; Wilkinson et al., 2016). Open-access publications and data repositories show a trend of increasing public participation in research (Evans & Reimer, 2009). On the other hand, big data and algorithmic analytics are changing the way scientists construct theories: truth now emerges more from massive correlations than from the verification of single hypotheses (Kitchin, 2014). These results show that the digital paradigm places data, networks, and algorithms as the main epistemic components in the formation of knowledge.

Digital epistemology can be understood as a form of networked epistemology, which is a knowledge system that depends on interactions between humans, machines, and institutions. Unlike the classical paradigm that places scientists as autonomous subjects, this model emphasizes the role of cross-disciplinary and cross-location collaboration. Nelson, (1989) explains this phenomenon through Actor-Network theory, in which material objects including software, data, and algorithms play an active role in shaping scientific truth. In the context of digital research, truth is no longer an individual product, but rather the result of negotiation within a distributed knowledge ecosystem.

Hermeneutic analysis shows that the construction of knowledge is not only social but also material. Hewitt, (2001) asserts that science is an interaction between the material world and the social practices of scientists. This is reinforced by (Constant & Pickering, 1997), who describes science as a “mangle of practice” between human and non-human agents. In the context of digital scholarship, this relationship is evident in the role of technology as an epistemic mediator: search engines, classification algorithms, and automatic citation systems not only disseminate information but also construct the structure of knowledge validity. These results show that digital epistemology cannot be separated from the material dimension of technology.

Digital literature analysis reveals changes in the structure of knowledge production. Platforms such as ResearchGate, Mendeley, and Zenodo enable more horizontal scientific interaction. Empirical data shows an increase in the use of altmetrics as an indicator of scientific credibility (Bornmann, 2014; Thelwall et al., 2013). Meanwhile, the FAIR data principles Wilkinson et al., (2016) mark a shift towards standardized openness practices. These facts confirm that the scientific validation process now takes place in a transparent and collaborative digital space, rather than in the closed space of academic institutions as in classical epistemology.

Other findings indicate the existence of a political dimension in digital knowledge infrastructure. Bowden, (2020) reminds us that every knowledge regime is always accompanied by power structures. In this context, algorithms and data systems act as a new form of regime of truth that determines what can be known and recognized as valid. Lemieux, (2017) asserts that data is not a neutral entity; it is the result of social, technical, and institutional decisions. Thus, although digital scholarship expands access and participation, it also creates new inequalities through control over platforms and data infrastructure.

A comparative analysis of classical and digital epistemology shows a shift in the sources of scientific authority. In the classical paradigm, legitimacy is obtained through peer review and academic institutions; while in the digital paradigm, authority is built through openness, collaboration, and network reputation. Hicks et al., (2015) through the Leiden Manifesto emphasizes that digital metrics and indicators must be used contextually so as not to replace substantive scientific assessment. Digital scholarship demands a new form of validity based on social credibility and process transparency.

Empirical studies show that scientific evaluation systems are shifting from quantitative to qualitative logic. Altmetrics, online engagement metrics, and open data usage are complementing conventional citations. Piwowar & Vision, (2013) show that works with open data have a wider impact. Thus, scientific truth is no longer measured solely through journal exclusivity, but through the ability to build dialogue with society and the digital community. This transformation broadens the meaning of scientific validity into a participatory and relational form.

Based on all the analysis results, it can be concluded that knowledge construction in the digital age is a synthesis of three major currents: i) classical rationalism, which still maintains the principle of logical validity, ii) social constructivism, which emphasizes the socio-historical context, and iii) digital ecology, which emphasizes interconnectedness and collaboration. This new epistemological model can be referred to as reflexive digital epistemology, which is a knowledge system that is aware of its socio-technological conditions, open to collective participation, and reflective of the ethics and power that accompany it.

The results of the study show that the epistemological shift from classical to digital is not only a methodological phenomenon, but also a philosophical transformation that changes the relationship between knowledge, technology, and society. Digital scholarship is a concrete representation of Mode 2 Knowledge Production (Atkinson, 1995), in which knowledge is produced in cross-disciplinary and cross-geographical networks. This transformation has resulted in a new paradigm that combines scientific rationality with social collaboration, making scientific truth the result of reflective interaction between humans and technology.

Philosophically, the results of this study confirm the relevance of the paradigm shift concept from (Wilkinson et al., 2016). The shift towards digital epistemology shows that scientific validity criteria are no longer universal but contextual and dependent on the digital ecosystem. Bowden, (2020) helps explain that this change involves the formation of a new episteme, a knowledge structure controlled by data logic and algorithms. Thus, digital science presents a new regime of truth that is reflexive towards power, different from the universal objectivity believed by the classical paradigm.

Compared to classical epistemology, digital scholarship offers a more dynamic form of validation. Popper, (2005) emphasizes falsification as a rational mechanism, whereas in the digital context, that mechanism is replaced by data openness and collective verification. Whereas scientific authority once originated from academic institutions, it now emerges from collaborative networks and public participation.

Thus, digital epistemology is not merely a technological adaptation, but a paradigm shift towards the democratization of knowledge.

This paradigm shift has significant ethical implications. When algorithms and platforms become part of scientific practice, questions arise about epistemic responsibility and structural bias. In line with (Bezuidenhout et al., 2017; Leonelli, 2014), dependence on digital data has the potential to reinforce the gap between the center and the periphery of science production. Therefore, ethical reflection is an integral part of digital epistemology: openness does not only mean free access, but also fairness in the distribution and representation of knowledge.

In the realm of policy, the results of this study indicate the need for a shift in the scientific evaluation system from narrow quantification to assessment based on social and collaborative contributions. The FAIR principles, open peer review, and open access need to be integrated into academic policy so that transparency and collaboration become core values. Higher education institutions must adjust scientific reward mechanisms to recognize non-traditional contributions such as data sharing, collaborative projects, and public communication activities.

The results of this study show that digital epistemology opens up space for the democratization of science, but also poses new risks in the form of infrastructure inequality and algorithmic dominance. Therefore, further studies need to be directed towards digital ethnographic analysis or empirical studies of open science communities. This approach can deepen our understanding of how the principles of transparency, openness, and epistemic justice are actually implemented. Thus, digital epistemology becomes not only a theoretical narrative, but also a socially just practice in the construction of contemporary science.

Epistemological Shift and Reconstruction of Islamic Education Science

The epistemological shift from the classical paradigm to the digital paradigm has had a profound influence on the construction of Islamic education science. The tradition of Islamic education since classical times has been rooted in bayani epistemology, which emphasizes the authority of texts and scientific *sanad* (Al-Attas, 1980). The validity of science is determined through the continuity of knowledge transmission between teachers and students. However, digitization has shifted this pattern towards a new epistemic structure that is more open and participatory. Free access to classical Islamic literature through digital libraries, such as *Al-Maktabah al-Shamilah* or Open Islamica, means that scientific authority is no longer the monopoly of certain institutions. Thus, the concept of scientific certification has expanded in meaning: from individual legitimacy to validation by a global scientific community based on networked epistemology.

In the context of digital epistemology, Islamic education faces challenges in maintaining a balance between revelation and reason in the digital ecosystem. Knowledge in Islam is not merely the result of human rationality, but part of a sacred cosmic order. When digitization places data as the main source of knowledge, Islamic education must ensure that the use of technology does not reduce the spiritual meaning of knowledge. Islamic educational institutions need to instill critical digital literacy, teaching students to read and verify information through the ethical framework of *ta'dib* (Al-Attas, 1980). Thus, the integration of Islamic and digital epistemology not only develops technological skills but also maintains the transcendental orientation of knowledge.

In addition to rational and spiritual dimensions, the scientific construction of Islamic education also requires strengthening ethical aspects and epistemic responsibility. In the digital environment, algorithms and data often form unconscious biases in knowledge (Leonelli, 2014). Islamic scientific principles such as scientific trustworthiness, sincerity, and fairness form the basis for presenting fair knowledge ethics. Bowden, (2020) reminds us that knowledge is always related to power; therefore, Islamic education needs to foster critical awareness so as not to be trapped in a regime of truth controlled by technology. Digital epistemology based on Islamic values must ensure that knowledge is used for the common good, not merely for efficiency or algorithmic profit.

The development of collaborative platforms such as ResearchGate, Mendeley, and Zenodo also opens up opportunities for the birth of a global scientific community. This phenomenon reflects the idea of scientific *ukhuwah* (brotherhood) that emphasizes cross-national and cross-disciplinary collaboration. In this context, digital Islamic education can become a space for dialogue between classical texts and the context of modernity, bringing together the intellectual heritage of Islam with contemporary scientific methodologies. The involvement of Muslim scholars, academics, and scientists in global knowledge networks marks a shift from epistemological taqlid to technology-based collective ijtihad. This strengthens Islam's position as a participatory and dynamic scientific civilization.

The scientific construction of Islamic education in the digital age needs to be directed towards the formation of an integrative epistemology that combines spiritual, social, and technological values. According to AbuSulayman, (1989), the Islamization of science must be carried out by uniting revelation and reason within the framework of *tauhid* epistemology. Through this approach, science is not separated from its moral and spiritual values. Digital Islamic education must develop a reflection- and collaboration-based learning model so that students become not only users of technology, but also ethical knowledge developers oriented towards social justice. Thus, digitization becomes a medium for epistemic *tajdid* that expands the function of Islamic education as a vehicle for the formation of *insan kamil.*

Digital transformation also requires a change in the pedagogical paradigm. Islamic learning is now moving from a transmissive model to a participatory one, where teachers act as epistemic facilitators (Anderson & Dron, 2011). Online platforms enable peer learning and open discussion that support joint meaning construction. In the context of modern *ta'dib*, digital interactions must be directed towards fostering thinking skills, reflective awareness, and scientific responsibility. Teachers play a role in guiding students to be able to navigate the global flow of information with Islamic wisdom, not just consume data. Therefore, digital literacy in Islamic education needs to be accompanied by moral and spiritual literacy so that Islamic epistemology remains intact amid the flow of disruption.

The scientific construction of Islamic education in the digital age requires methodological research renewal. Contemporary Islamic studies must utilize multidisciplinary approaches, including data analysis, digital ethnography, and network analysis to understand socio-religious dynamics (Larkin, 2002). This approach enriches Islamic epistemology so that it can answer contemporary issues scientifically and contextually. However, the integration of digital methods must remain grounded in the principles of *maqashid al-syari'ah*, ensuring that every scientific innovation brings benefits and justice. Thus, Islamic education in the digital age is not only adaptive to change, but also proactive in building a civilization of knowledge rooted in the values of tawhid and humanity.

Finally, in the ever-evolving landscape of digital epistemology, Muslim scientists are required to be more active in filling the digital space with authentic and credible Islamic scientific knowledge. This challenge is increasingly important considering that digitization not only changes the way science is disseminated, but also the way it is constructed, validated, and understood in global society. According to Ardiansyah et al., (2019), knowledge in Islam is *ta'dibiy* in nature, containing moral, spiritual, and ethical dimensions; therefore, mastery of digital technology must be positioned as a means of maintaining the sanctity and epistemological accuracy of this knowledge. Mastery of digital devices is a must, not only to facilitate the dissemination of knowledge, but also to ensure that Islamic concepts are not distorted by knowledge constructs shaped by algorithms, platform biases, or external narratives that are not in line with *maqāṣid al-syarī'ah*. This is in line with Leonelli, (2014) warning that data and algorithms can form epistemic biases that influence perceptions of truth.

Therefore, Muslim scientists need to have critical sensitivity in reading the epistemic framework that works behind digital platforms, as emphasized by Bowden, (2020) that every production of knowledge is always related to power relations. Scientists also need to be proactive in developing scientific content that reflects the depth of the Islamic intellectual tradition while being compatible with modern digital communication structures. This commitment not only maintains the purity and perfection of science, as emphasized by Nasr, (2024), but also ensures that the digital space becomes a field of intellectual da'wah that is down-to-earth, relevant, and capable of strengthening Islamic civilization in the era of global knowledge networks. Thus, the active involvement of Muslim scientists in the digital ecosystem is part of a collective effort to build an adaptive, critical, and transformative Islamic epistemology.

CONCLUSION

This study confirms a significant epistemological shift from the classical framework based on rationality, empiricism, and institutional authority towards a digital epistemology based on openness, collaboration, and networks. A synthesis of the literature shows that the concepts of paradigm shift (Kuhn) and episteme/power–knowledge (Foucault) provide a lens for understanding how data infrastructure, algorithms, and digital platforms shape a new regime of truth. Meanwhile, Actor–Network Theory (Latour), interactive realism (Hacking), the mangle of practice (Pickering), and Mode 2 Knowledge Production (Gibbons et al.) explain the human–technology–institution relationship in knowledge production that is increasingly transdisciplinary and applicative. At the practical level, digital scholarship promotes transparency, reproducibility, FAIR data, altmetrics, and open peer review, so that scientific validity is increasingly supported by network credibility and public accountability, rather than solely hierarchical verification.

The main strength of this study lies in its cross-tradition integration: combining classical philosophy of science (Popper, Lakatos, Feyerabend), genealogy of knowledge (Foucault), sociology of science and materiality of technology (Latour, Knorr Cetina, Hacking, Pickering), with contemporary literature on big data, open science, and digital scholarship (Borgman, Weller, Kitchin, boyd & Crawford, Wilkinson/FAIR, Munafò et al., Hicks/Leiden). The hermeneutic-comparative approach enables the mapping of epistemic continuities and discontinuities in an argumentative manner, resulting in a conceptual model of "reflexive digital epistemology": a context-aware, data-intensive, collaborative knowledge ecology that is sensitive to the ethical-political dimensions of technology. This framework contributes theoretically to the philosophy of science, while also offering a normative basis for scientific policy (context-based evaluation, recognition of data/collaboration contributions, and mainstreaming of open science).

The main limitation of this study lies in its empirical basis, which still relies on literature reviews; no field observations/digital ethnography have been conducted in research communities that implement open data, open code, or open peer review. In addition, because data technology and policies are developing rapidly, the generalization of findings is temporal and requires periodic updates. Further studies are recommended to: i) conduct cross-disciplinary/cross-country comparative case studies on the implementation of FAIR, reproducibility, and altmetrics; ii) evaluate epistemic justice and the risk of algorithmic bias, including data coloniality and infrastructure inequality; iii) design evaluation indicators that balance quantitative metrics with qualitative peer judgment and social impact. Thus, the future agenda is not only to refine the theory of digital epistemology, but also to ensure that it operates inclusively, fairly, and responsibly in the construction of contemporary science.

REFERENCES

AbuSulayman, A. (1989). Islamization of knowledge: General principles and work plan. In *International Institute of Islamic Thought*. International Institute of Islamic Thought.

Al-Attas, S. M. N. (1980). *The concept of education in Islam*. ISTAC.

Anderson, T., & Dron, J. (2011). Three generations of distance education pedagogy. *International Review of Research in Open and Distance Learning*, *12*(3), 80–97. https://doi.org/10.19173/irrodl.v12i3.890

Ardiansyah, M., Hafidhuddin, D., Mujahidin, E., & Syafrin, N. (2019). The concept of adâb by Syed Muhammad Naquib al-Attas and its relevance to education in Indonesia. *Ibn Khaldun Journal of Social Science*, *1*(1), 53–63. https://doi.org/10.32832/ikjss.v1i1.2385

Aryasutha, R., Azizah Ria Kusrini, N., Nurul Ulya, J., & Syamsiah Septiani, N. (2025). Opportunities and Challenges for Islamic Education Teachers in Using Artificial Intelligence in Learning. *Muaddib.Intischolar.Id*, *2*(1), 43. https://muaddib.intischolar.id/index.php/muaddib/article/view/6

Atkinson, R. (1995). The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies (Book Review). In *College & Research Libraries* (Vol. 56, Issue 6). Sage Publications. https://doi.org/10.5860/crl_56_06_558

Bezuidenhout, L. M., Leonelli, S., Kelly, A. H., & Rappert, B. (2017). Beyond the digital divide: Towards a situated approach to open data. *Science and Public Policy*, *44*(4), 464–475. https://doi.org/10.1093/scipol/scw036

Borgman, C. L. (2007). Scholarship in the Digital Age. In *Scholarship in the Digital Age*. MIT Press. https://doi.org/10.7551/mitpress/7434.001.0001

Bornmann, L. (2014). Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics. *Journal of Informetrics*, *8*(4), 895–903. https://doi.org/10.1016/j.joi.2014.09.005

Bowden, B. (2020). The Intellectual Origins of Postmodernism. In *The Palgrave Handbook of Management History* (pp. 645–669). https://doi.org/10.1007/978-3-319-62114-2_77

Constant, E., & Pickering, A. (1997). The Mangle of Practice: Time, Agency, and Science. In *Technology and Culture* (Vol. 38, Issue 3). University of Chicago Press. https://doi.org/10.2307/3106908

Engkizar, E., Alhadi, M., & Akyuni, Q. (2024). Indonesian International Student Mobility Awards Program: Chances and Challenges. In *JIASMY Journal* (Vol. 1, Issue 1, pp. 41–56). https://jiasmy.intischolar.id/index.php/jiasmy/article/view/4

Engkizar, E., Jaafar, A., Hamzah, M. I., Langputeh, S., Rahman, I., & Febriani, A. (2025). Analysis Problems of Quranic Education Teachers in Indonesia: Systematic Literature Review. *International Journal of Islamic Studies Higher Education*, *4*(2), 92–108. https://doi.org/10.24036/insight.v4i2.232

Engkizar, E., Jaafar, A., Taufan, M., Rahman, I., Oktavia, G., & Guspita, R. (2023). Quran Teacher: Future Profession or Devotion to the Ummah? *International Journal of Multidisciplinary of Higher Education (IJMURHICA)*, *6*(4), 633–644. https://doi.org/10.24036/ijmurhica.v6i4.321

Evans, J. A., & Reimer, J. (2009). Open access and global participation in science.

Science, *323*(5917), 1025. https://doi.org/10.1126/science.1154562
Hewitt, J. P. (2001). The social construction of social construction. In *Qualitative Sociology* (Vol. 24, Issue 3). Harvard University Press. https://doi.org/10.1023/A:1010699110017
Hicks, D., Wouters, P., Waltman, L., De Rijcke, S., & Rafols, I. (2015). Bibliometrics: The Leiden Manifesto for research metrics. *Nature*, *520*(7548), 429–431. https://doi.org/10.1038/520429a
Hooley, T. (2013). The digital scholar: how technology is transforming scholarly practice. In *British Journal of Guidance & Counselling* (Vol. 41, Issue 3). Bloomsbury Academic. https://doi.org/10.1080/03069885.2013.778013
Jaafar, A., Kamaruzaman, N. R., & Idris, M. (2025). The Concept and Practice of Islamic Education in Realizing Peace in Society. *Muaddib: Journal of Islamic Teaching and Learning*, *1*(2), 24–35. https://muaddib.intischolar.id/index.php/muaddib/article/view/10
Kitchin, R. (2014). Big Data, new epistemologies and paradigm shifts. *Big Data and Society*, *1*(1). https://doi.org/10.1177/2053951714528481
Kuhn, T. (2021). The structure of scientific revolutions. In *Philosophy after Darwin: Classic and Contemporary Readings* (4th ed.). University of Chicago Press. https://doi.org/10.2307/j.ctv1jk0jrs.26
Lakatos, I. (1970). Criticism and the Growth of Knowledge. In Musgrave (Ed.), *Philosophical Studies* (Vol. 20, Issue 0). Cambridge University Press. https://doi.org/10.5840/philstudies197120081
Larkin, B. (2002). New Media in the Muslim World: The Emerging Public Sphere. In *American Ethnologist* (2 (, Vol. 29, Issue 1). Indiana University Press. https://doi.org/10.1525/ae.2002.29.1.191
Lemieux, T. M. (2017). Big Data, Little Data, No Data: Scholarship in the Networked World. In *Canadian Journal of Communication* (Vol. 42, Issue 1). MIT Press. https://doi.org/10.22230/cjc.2017v42n1a3152
Leonelli, S. (2014). What difference does quantity make? On the epistemology of Big Data in biology. *Big Data and Society*, *1*(1). https://doi.org/10.1177/2053951714534395
Markovsky, B., & Cetina, K. K. (2000). Epistemic Cultures: How the Sciences Make Knowledge. In *Contemporary Sociology* (Vol. 29, Issue 3). Harvard University Press. https://doi.org/10.2307/2653984
Munafò, M. R., Nosek, B. A., Bishop, D. V. M., Button, K. S., Chambers, C. D., Percie Du Sert, N., Simonsohn, U., Wagenmakers, E. J., Ware, J. J., & Ioannidis, J. P. A. (2017). A manifesto for reproducible science. *Nature Human Behaviour*, *1*(1), 21. https://doi.org/10.1038/s41562-016-0021
Nasr, S. H. (2024). Islamic Philosophy from Its Origin to the Present. In *Islamic Philosophy from Its Origin to the Present*. State University of New York Press. https://doi.org/10.2307/jj.18254484
Nelson, H. E. (1989). Science in action. In *Fire journal Boston, Mass.* (Vol. 83, Issue 4). Harvard University Press. https://doi.org/10.4324/9781003281719-8
Piwowar, H. A., & Vision, T. J. (2013). Data reuse and the open data citation advantage. *PeerJ*, *2013*(1), 175. https://doi.org/10.7717/peerj.175
Popper, K. (2005). The logic of scientific discovery. In *The Logic of Scientific Discovery* (2nd ed.). Routledge. https://doi.org/10.4324/9780203994627
Putri, N., Noprianti, A., & Oktavia, G. (2025). The Qur'an as a Source of Solutions for the Global Moral Crisis. *Journal of Quranic Teaching and Learning*, *1*(2), 90–105. https://joqer.intischolar.id/index.php/joqer
Tennant, J. P., Waldner, F., Jacques, D. C., Masuzzo, P., Collister, L. B., & Hartgerink, C. H. J. (2016). The academic, economic and societal impacts of Open Access: an evidence-based review. *F1000Research*, *5*, 632.

https://doi.org/10.12688/f1000research.8460.3
Thelwall, M., Haustein, S., Larivière, V., & Sugimoto, C. R. (2013). Do Altmetrics Work? Twitter and Ten Other Social Web Services. *PLoS ONE*, *8*(5), 64841. https://doi.org/10.1371/journal.pone.0064841
Ummah, A. K., Kakoh, N. A., Mahmudi, M. B., Wardani, A. Z., & Ummah, A. K. (2025). Efforts of Dormitory Supervisors in Overcoming Problems in the Quran Memorization Dormitory. *Journal of Theory and Research Memorization Quran*, *1*(1), 1–14. https://joesmiq.intischolar.id/index.php/joesmiq/article/view/52
Vicente-Saez, R., & Martinez-Fuentes, C. (2018). Open Science now: A systematic literature review for an integrated definition. *Journal of Business Research*, *88*, 428–436. https://doi.org/10.1016/j.jbusres.2017.12.043
Wilkinson, M. D., Dumontier, M., Aalbersberg, Ij. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J. W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., … Mons, B. (2016). Comment: The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, *3*, 160018. https://doi.org/10.1038/sdata.2016.18
Wilson, M., & Feyerabend, P. (1978). Against Method. In *The Philosophical Review* (3rd ed., Vol. 87, Issue 1). Verso. https://doi.org/10.2307/2184355