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Reconfiguring Educational Epistemology in the Age of Artificial Intelligence: Between Knowledge Authority and Learning Automation

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Abstract
This study examines the **epistemological transformation of education in the era of artificial intelligence (AI)**, focusing on the shifting authority of knowledge, the automation of learning processes, and their implications for educational practices. As AI increasingly mediates how knowledge is produced, validated, and accessed, traditional human-centered epistemic structures are being redefined. This research employs a qualitative approach using a Systematic Literature Review (SLR), analyzing recent peer-reviewed journal articles from databases such as Scopus, Web of Science, and Google Scholar. Data were collected through a rigorous screening process based on relevance and methodological quality, and analyzed using thematic and content analysis to identify key patterns across epistemological, technological, and ethical dimensions. The findings reveal that knowledge authority is becoming distributed between humans and algorithmic systems, while AI-driven automation enhances efficiency and personalization but risks reducing critical engagement and conceptual depth. Additionally, the emergence of data-driven and opaque knowledge systems requires new competencies, including AI literacy and epistemic awareness. The study concludes that a comprehensive reconfiguration of educational epistemology is necessary, emphasizing the integration of technological innovation with critical thinking, ethical responsibility, and epistemic justice to ensure meaningful and sustainable learning in the AI era.

Keywords: *Artificial Intelligence, Educational Epistemology, Knowledge Authority, Learning Automation, Epistemic Justice*

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Introduction
The rapid advancement of Artificial Intelligence (AI) has not only transformed technological infrastructures but has also fundamentally reshaped the epistemological foundations of education. In contemporary educational discourse, AI is no longer perceived merely as a supportive tool; rather, it functions as a transformative force that redefines how knowledge is produced, validated, distributed, and taught. This shift is particularly evident in higher education and professional learning environments, where algorithmic systems, generative models, and immersive digital platforms increasingly mediate access to knowledge. As a result, the traditional epistemic hierarchy—where knowledge authority resided primarily in educators, scholars, and institutions—is undergoing a significant transformation. Authority is now distributed among human actors, algorithmic systems, and data-driven infrastructures,

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creating a hybrid epistemic ecosystem that challenges conventional assumptions about truth, expertise, and learning.

One of the most striking phenomena in this transformation is the **shifting authority of knowledge** from human experts to algorithmic systems and digital platforms. Historically, knowledge legitimacy was grounded in institutional validation, peer review, and expert consensus. However, recent studies indicate that AI systems are increasingly perceived as authoritative sources of knowledge, particularly in contexts where they provide rapid, context-sensitive, and seemingly reliable outputs. Contreras-Piña and Román-Acosta (2024) and Sarkar (2023) argue that this shift has led to the emergence of new forms of epistemic authority, where "virtual teachers" and algorithmic agents function as knowledge intermediaries. These systems not only disseminate information but also shape how knowledge is interpreted and applied, thereby influencing learning processes at a fundamental level. This phenomenon raises critical concerns regarding the legitimacy and accountability of AI-generated knowledge, as well as the potential erosion of human expertise.

Furthermore, the concept of **epistemic rupture** has been introduced to describe the profound transformation in how knowledge is constructed and operationalized in the AI era. Levin (2026) highlights the emergence of what he terms "vibe-automation," where generative AI systems operate by identifying patterns and producing outputs based on probabilistic inference rather than explicit rules. In this context, human roles shift from knowledge producers to orchestrators who guide and align AI outputs. This transformation challenges traditional epistemological models that emphasize logical reasoning, explicit knowledge structures, and causal explanations. Instead, knowledge becomes increasingly fluid, context-dependent, and mediated by algorithmic processes. Such a shift has significant implications for education, as it requires learners to engage with knowledge that is not fully transparent or explainable.

Another critical dimension of this epistemological transformation is the tension between **material and statistical authority**. In traditional scientific epistemology, knowledge is grounded in empirical observation and interaction with the physical world. However, as Sandu (2025) argues, generative AI systems rely primarily on text-based data and statistical modeling, which may lack direct engagement with material reality. This creates a potential disconnect between knowledge representation and real-world phenomena, raising questions about the reliability and validity of AI-generated knowledge. In educational contexts, this tension highlights the need to balance data-driven insights with experiential and empirical learning, ensuring that students develop a comprehensive understanding of both theoretical and practical dimensions of knowledge.

In organizational and educational settings, AI has also transformed **knowledge practices**, particularly in terms of creation, storage, and validation. Research indicates that knowledge creation is increasingly driven by data analytics and generative models, shifting away from traditional human-centered theorizing (Alavi et al., 2024; Kotsis, 2025; Neher et al., 2025). Similarly, knowledge storage and retrieval have evolved from static repositories to dynamic, conversational interfaces mediated by AI systems. This transformation enhances accessibility and efficiency but also raises concerns about information reliability and contextual accuracy. Perhaps most critically, the validation of knowledge is increasingly dependent on the performance of opaque, "black-box" models, rather than transparent processes of peer review and expert evaluation (Mortlock & Lucas, 2024; Rois & Yazdani, 2026; Taherdoost & Madanchian, 2023; Bag et al., 2021). This shift challenges the epistemic foundations of education, as learners must navigate systems whose underlying mechanisms are not fully understood.

The **automation of learning** further intensifies these epistemological challenges. AI-driven educational technologies, such as intelligent tutoring systems and generative content tools, enable the automation of various aspects of the learning process, including content generation, assessment, and feedback. While these technologies offer significant benefits in terms of efficiency and personalization, they also risk reducing learning to a procedural and outcome-oriented process. Bag et al. (2021) note that AI-based learning environments often prioritize what works over why it works, emphasizing practical effectiveness rather than conceptual understanding. This shift toward pragmatic learning may undermine the development of critical thinking and deep epistemic engagement, as students become passive consumers of AI-generated knowledge.

Moreover, the emergence of **black-box learning environments** poses significant challenges for educational epistemology. Rois and Yazdani (2026) and Taherdoost and Madanchian (2023) define AI systems as inherently opaque, producing outputs that are difficult to trace or explain. In such environments, learners must develop the ability to work with partial, ambiguous, and uncertain

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information. This represents a departure from traditional educational models that emphasize clarity, transparency, and logical reasoning. Instead, education must equip students with the skills to critically evaluate AI-generated outputs, question their assumptions, and understand their limitations. This requires a shift from knowledge acquisition to epistemic awareness, where learners are trained to navigate complex and uncertain knowledge landscapes.

The rise of **data-driven epistemology** further complicates the educational landscape. AI systems conceptualize knowledge as dynamic, probabilistic, and model-based, challenging traditional views of knowledge as static and objective. Tang and Cooper (2024) and Taherdoost and Madanchian (2023) argue that this shift necessitates a rethinking of educational content and pedagogy, emphasizing critical scrutiny of AI-generated knowledge. Students must learn to interpret data-driven insights, understand their probabilistic nature, and recognize the limitations of algorithmic models. This transformation underscores the need for a more sophisticated epistemological framework that integrates data literacy, critical thinking, and ethical awareness.

Despite these significant transformations, current educational practices have not fully adapted to the epistemological challenges posed by AI. One of the key research gaps lies in the lack of **integrated frameworks** that address the interplay between knowledge authority, learning automation, and epistemological transformation. Existing studies tend to focus on specific aspects of AI in education, such as technological implementation or pedagogical outcomes, without considering the broader epistemological implications. Furthermore, there is limited attention to how educational systems can balance the benefits of AI with the need to preserve human-centered values, such as critical thinking, ethical reasoning, and epistemic responsibility.

Another critical gap concerns the **ethical and epistemic justice dimensions** of AI in education. Issues such as algorithmic bias, data privacy, and digital inequality have been directly linked to questions of epistemic justice, including whose knowledge is represented, whose voices are marginalized, and whose perspectives are prioritized (Contreras-Piña & Román-Acosta, 2024; Farida, 2025; Ifenthaler & Schumacher, 2023; Kamalov et al., 2023). These concerns highlight the need for educational frameworks that promote inclusivity, fairness, and accountability in AI-mediated learning environments. Without such frameworks, there is a risk that AI systems may reinforce existing inequalities and perpetuate epistemic injustices.

In response to these challenges, scholars have called for a **reconfiguration of educational epistemology** that reflects the realities of the AI era. This involves redefining the roles of teachers, learners, and technology in the learning process. As Sarkar (2023) argues, educators must move beyond their traditional role as knowledge transmitters and become facilitators who guide students in developing critical thinking, ethical judgment, and AI literacy. Similarly, curriculum design must be reoriented to incorporate new forms of knowledge and skills, including the ability to interact with AI systems, understand their limitations, and critically evaluate their outputs (Levin, 2026; Taherdoost & Madanchian, 2023).

In addition, there is a growing emphasis on integrating **AI literacy and epistemic awareness** into educational curricula, particularly in fields such as science, medicine, and engineering. Studies suggest that students must be equipped with the skills to understand the opacity, uncertainty, and emergent properties of AI systems, as well as their implications for knowledge production (Gordon et al., 2024; Rincón et al., 2025; Krive et al., 2023; Jarrahi et al., 2022; Tang & Cooper, 2024; Sandu, 2025). This requires a shift from traditional content-based education to a more holistic approach that emphasizes critical engagement with knowledge and technology.

The novelty of this study lies in its effort to **integrate multiple dimensions of AI's impact on education**—including knowledge authority, learning automation, and epistemological transformation—into a unified conceptual framework. Unlike previous studies that examine these dimensions separately, this research provides a comprehensive synthesis that highlights their interconnections and implications for educational practice. Furthermore, this study emphasizes the importance of ethical and epistemic justice considerations, offering a more holistic perspective on the challenges and opportunities of AI in education.

Based on the identified phenomena, research gaps, and proposed novelty, the primary objective of this study is to systematically analyze and synthesize the epistemological transformation of education in the era of artificial intelligence, with a focus on the shifting authority of knowledge, the automation of learning processes, and the implications for educational practice and policy. Through this analysis, the study aims to develop an integrative framework that supports the reconfiguration of educational

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epistemology, ensuring that learning remains meaningful, critical, and ethically grounded in an increasingly AI-mediated world.

Methodology

This study employs a qualitative approach using a **Systematic Literature Review (SLR)** design to analyze the epistemological transformation of education in the era of artificial intelligence, particularly focusing on the shifting authority of knowledge, learning automation, and their implications for educational practices. The selection of this method aligns with the research objective, which seeks to synthesize recent theoretical and empirical studies to construct an integrative conceptual framework. Data collection was conducted through a structured and comprehensive search of reputable academic databases, including Scopus, Web of Science, ScienceDirect, and Google Scholar. The search process utilized specific keywords such as "AI in education," "epistemology of education," "knowledge authority," "learning automation," "generative AI," and "epistemic justice." The inclusion criteria consisted of (1) peer-reviewed journal articles published between 2021 and 2026, (2) studies addressing epistemological, pedagogical, or ethical dimensions of AI in education, and (3) articles with clear theoretical or empirical contributions. Meanwhile, exclusion criteria included non-indexed publications, opinion pieces without scholarly grounding, and studies not directly relevant to educational contexts. The data collection procedure followed systematic stages, including identification, screening of titles and abstracts, full-text review, and final selection based on relevance, rigor, and alignment with the research focus.

The data analysis employed a **thematic analysis approach** combined with qualitative content analysis to identify patterns and relationships across the selected literature. Initially, open coding was conducted to extract key concepts related to knowledge authority (e.g., human vs. algorithmic authority), learning automation (e.g., generative AI, adaptive systems), and epistemological implications (e.g., opacity, uncertainty, epistemic justice). These codes were then organized into broader thematic categories through axial coding, enabling the identification of interconnections among cognitive, technological, and ethical dimensions. A constant comparative method was applied to ensure consistency and depth of interpretation by continuously comparing findings across studies. The final stage involved narrative synthesis, where the results were systematically interpreted to develop an integrative framework that explains how AI reshapes knowledge production, validation, and teaching practices. This analytical process ensures that the findings are comprehensive, theoretically grounded, and relevant for informing future educational policy, curriculum design, and pedagogical innovation in the AI era.

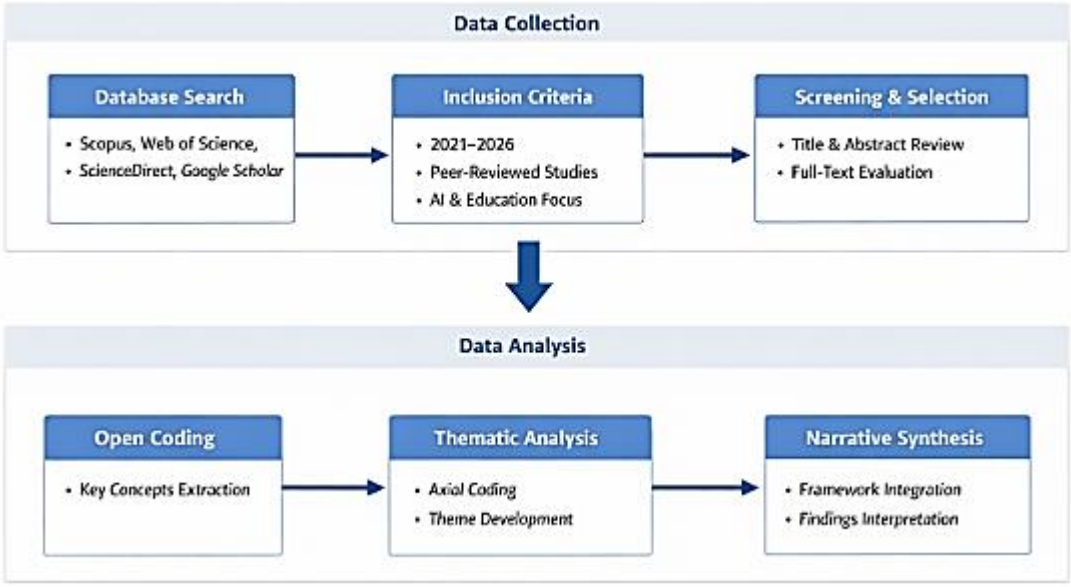

Figure 1. Diagram Conceptual Research

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Results and Discussion

Based on the systematic literature review conducted, the findings reveal that the **epistemological transformation of education in the era of artificial intelligence (AI)** is characterized by a shift in knowledge authority, the automation of learning processes, and the emergence of new ethical and epistemic challenges. These dimensions interact dynamically and reshape how knowledge is created, validated, and taught within educational systems. The following table presents a synthesized overview of the key findings derived from the analyzed studies.

Table 1. Integrated Findings on AI, Knowledge Authority, and Learning Automation in Education

Dimension	Key Transformation	Impact on Education	Challenges	Key References
Knowledge Authority	Shift from human experts to AI systems and platforms	Redefinition of teacher roles; emergence of "virtual authority"	Legitimacy, trust, and accountability of AI-generated knowledge	Contreras-Piña & Román-Acosta (2024); Sarkar (2023)
Knowledge Creation	From human theorization to data-driven and generative outputs	Faster knowledge production; increased accessibility	Loss of deep conceptual reasoning	Alavi et al. (2024); Kotsis (2025); Neher et al. (2025)
Knowledge Validation	From peer review to algorithmic/black-box validation	Efficiency in evaluation processes	Lack of transparency and explainability	Mortlock & Lucas (2024); Rois & Yazdani (2026); Taherdoost & Madanchian (2023); Bag et al. (2021)
Learning Automation	AI-driven content generation, feedback, and assessment	Personalized and scalable learning environments	Reduced critical thinking and over-reliance on AI	Bag et al. (2021); Rois & Yazdani (2026)
Epistemological Shift	From deterministic to probabilistic, data-driven knowledge	Development of data literacy and adaptive thinking	Difficulty understanding uncertainty and model limitations	Tang & Cooper (2024); Sandu (2025)
Teacher's Role	From knowledge transmitter to facilitator and mentor	Emphasis on critical thinking, ethics, and AI literacy	Need for new competencies and professional development	Sarkar (2023)
Curriculum & Pedagogy	Integration of AI literacy and interdisciplinary approaches	More relevant and future-oriented education	Curriculum redesign complexity	Levin (2026); Gordon et al. (2024); Rincón et al. (2025); Jarrahi et al. (2022)
Ethical & Epistemic Justice	Issues of bias, representation, and digital inequality	Awareness of fairness, inclusivity, and responsible AI use	Algorithmic bias, marginalization of certain knowledge systems	Farida (2025); Ifenthaler & Schumacher (2023); Kamalov et al. (2023)

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The findings presented in Table 1 demonstrate that the integration of AI into education has fundamentally altered the epistemological structure of learning, shifting authority from exclusively human sources to a hybrid system involving algorithms and digital platforms. This transformation enhances efficiency, accessibility, and personalization in knowledge processes but simultaneously introduces significant challenges related to transparency, trust, and ethical responsibility. The automation of learning processes, while beneficial in improving scalability and adaptability, raises concerns about the potential decline in critical thinking and deep conceptual understanding among learners. Furthermore, the emergence of data-driven and probabilistic knowledge frameworks requires students to develop new competencies, including AI literacy and epistemic awareness. Importantly, the findings also highlight the growing significance of ethical and epistemic justice considerations, emphasizing the need to ensure fairness, inclusivity, and accountability in AI-mediated education. Overall, the results suggest that addressing these challenges requires a comprehensive reconfiguration of educational epistemology that balances technological innovation with human-centered values and critical engagement.

Discussion

The findings of this study, derived from a systematic literature review, reveal that the integration of artificial intelligence (AI) into education constitutes a profound **epistemological transformation**, rather than merely a technological enhancement. In line with the research objective, this discussion synthesizes how AI reshapes the authority of knowledge, automates learning processes, and necessitates a reconfiguration of educational epistemology. The results presented in the table demonstrate that these transformations are interconnected and collectively redefine how knowledge is produced, validated, and taught in contemporary educational contexts, particularly within higher education and professional learning environments.

One of the most significant transformations identified is the **shifting authority of knowledge** from traditional human-centered sources to algorithmic and platform-based systems. Historically, epistemic authority in education was grounded in institutional legitimacy, scholarly expertise, and peer-reviewed validation. However, the findings indicate that AI systems are increasingly perceived as legitimate knowledge producers and mediators. Contreras-Piña and Román-Acosta (2024) and Sarkar (2023) highlight that this shift has led to the emergence of "virtual teachers" and algorithmic knowledge authorities, where legitimacy is constructed through digital performance, accessibility, and perceived accuracy. This transformation challenges the traditional hierarchy of knowledge and raises critical questions about trust, accountability, and epistemic reliability. As learners increasingly rely on AI-generated content, the locus of authority becomes distributed across human and non-human agents, creating a hybrid epistemic environment that requires new forms of critical engagement.

The concept of **epistemic rupture**, particularly through what Levin (2026) describes as "vibe-automation," further illustrates the depth of this transformation. Unlike traditional rule-based systems, generative AI operates by identifying patterns and producing contextually relevant outputs without explicit reasoning processes. This shifts the human role from knowledge creator to orchestrator, where educators and learners guide and refine AI-generated outputs rather than constructing knowledge independently. Such a shift has significant implications for epistemology, as it challenges the primacy of logical reasoning and explicit knowledge structures. Instead, knowledge becomes increasingly probabilistic, context-dependent, and mediated by algorithmic inference. This aligns with the findings in the table, which indicate that knowledge creation is moving from human theorization to data-driven pattern discovery (Alavi et al., 2024; Kotsis, 2025; Neher et al., 2025).

Another critical dimension of this transformation is the tension between **material and statistical authority**. Traditional scientific epistemology is grounded in empirical observation and interaction with the physical world, which provides a basis for validating knowledge claims. However, as Sandu (2025) argues, AI systems rely on statistical modeling and large-scale textual data, which may lack direct engagement with material reality. This creates a potential disconnect between knowledge representation and real-world phenomena, raising concerns about the validity and applicability of AI-generated knowledge. In educational contexts, this tension underscores the importance of maintaining a balance between data-driven insights and experiential learning, ensuring that students develop both theoretical understanding and practical competence.

The findings also highlight significant changes in **knowledge practices**, particularly in terms of creation, storage, and validation. AI-driven systems enable rapid knowledge creation through generative

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outputs, enhancing accessibility and efficiency but potentially reducing the depth of conceptual understanding. Similarly, knowledge storage and retrieval have shifted from curated repositories to conversational, AI-mediated systems, allowing learners to access information dynamically and interactively (Alavi et al., 2024; Kotsis, 2025; Neher et al., 2025). While these developments improve usability, they also introduce challenges related to information accuracy, contextual relevance, and epistemic trust. Most notably, the validation of knowledge is increasingly dependent on the performance of opaque "black-box" models rather than transparent processes of peer review and expert evaluation (Mortlock & Lucas, 2024; Rois & Yazdani, 2026; Taherdoost & Madanchian, 2023; Bag et al., 2021). This shift raises fundamental questions about how knowledge claims are justified and verified in AI-mediated environments.

The **automation of learning** further amplifies these epistemological challenges. AI technologies enable the automation of content generation, assessment, and feedback, creating personalized and scalable learning environments. However, the findings indicate that this automation may lead to a shift from deep understanding to pragmatic usage. Bag et al. (2021) argue that AI-driven learning environments often prioritize effectiveness over explanation, encouraging students to focus on what works rather than why it works. This trend risks undermining critical thinking and reflective learning, as students become passive recipients of AI-generated knowledge. Furthermore, the emergence of **black-box learning environments** requires learners to engage with systems that produce outputs without transparent reasoning processes. Rois and Yazdani (2026) and Taherdoost and Madanchian (2023) emphasize that education must prepare students to navigate such environments, developing skills to critically evaluate and interpret opaque AI outputs.

The transition toward a **data-driven epistemology** further reinforces the need for epistemological reconfiguration. AI systems conceptualize knowledge as dynamic, probabilistic, and model-based, challenging traditional views of knowledge as fixed and objective. Tang and Cooper (2024) and Sandu (2025) highlight that this shift requires learners to develop new competencies, including data literacy, probabilistic reasoning, and critical evaluation of algorithmic outputs. The findings suggest that education must move beyond content transmission toward fostering epistemic awareness, where students understand the limitations, uncertainties, and biases inherent in AI-generated knowledge.

In response to these transformations, the role of educators is undergoing a fundamental redefinition. The findings indicate that teachers are no longer the primary sources of knowledge but are instead facilitators who guide students in navigating complex epistemic environments. Sarkar (2023) emphasizes that educators must focus on developing students' critical thinking, ethical judgment, and "third literacy," which refers to the ability to interact effectively with AI systems. This shift aligns with the broader trend toward learner-centered education, where the emphasis is on developing skills rather than transmitting content. However, this transformation also presents challenges, as educators must acquire new competencies and adapt to rapidly evolving technological contexts.

The need for **curriculum and pedagogical redesign** is another key implication of the findings. In computer science education, there is a shift from rule-based paradigms to generative, context-driven approaches, reflecting the transition from symbolic to "vibe-based" automation (Levin, 2026; Taherdoost & Madanchian, 2023). In fields such as science and medicine, there is a growing emphasis on integrating AI literacy and epistemic insights, including understanding the opacity, uncertainty, and emergent properties of AI systems (Gordon et al., 2024; Rincón et al., 2025; Krive et al., 2023; Jarrahi et al., 2022; Tang & Cooper, 2024; Sandu, 2025). More broadly, higher education must prepare students to navigate AI-mediated environments, emphasizing critical engagement, ethical awareness, and interdisciplinary learning (Slimi, 2023; Mortlock & Lucas, 2024; Jarrahi et al., 2022; Sarkar, 2023).

The discussion also highlights the importance of **ethical frameworks and epistemic justice** in AI-mediated education. The findings indicate that issues such as algorithmic bias, data privacy, and digital inequality are closely linked to questions of epistemic justice, including whose knowledge is represented and whose voices are marginalized. Contreras-Piña and Román-Acosta (2024), Farida (2025), Ifenthaler and Schumacher (2023), and Kamalov et al. (2023) emphasize that AI systems can reinforce existing inequalities if not carefully designed and implemented. This underscores the need for educational frameworks that promote inclusivity, fairness, and accountability. Furthermore, scholars advocate for a humanistic approach to education that prioritizes human dignity and critical consciousness over purely metric-driven outcomes (Farida, 2025; Restiawati & Masruhim, 2026; Janumpally et al., 2025).

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In synthesizing these findings, it becomes evident that the epistemological transformation driven by AI is both an opportunity and a challenge. On one hand, AI enhances the accessibility, efficiency, and personalization of education, enabling new forms of knowledge creation and learning. On the other hand, it introduces significant challenges related to epistemic authority, transparency, and ethical responsibility. The discussion demonstrates that addressing these challenges requires a comprehensive and integrated approach that considers cognitive, technological, pedagogical, and ethical dimensions.

Ultimately, this study contributes to the understanding of how AI reshapes the epistemological foundations of education by providing an integrative framework that connects knowledge authority, learning automation, and epistemic reconfiguration. In line with the research objective, the findings highlight the need for educational systems to adapt to the realities of the AI era, ensuring that learning remains critical, reflective, and ethically grounded. This requires not only technological innovation but also a fundamental rethinking of the purposes and practices of education, positioning it as a transformative process that empowers learners to navigate and shape an increasingly complex and AI-mediated world.

Conclusion

This study concludes that the integration of artificial intelligence (AI) in education represents a profound epistemological transformation that fundamentally reshapes the authority, production, validation, and transmission of knowledge. In line with the research objective, the findings demonstrate that knowledge authority is no longer exclusively centered on human experts but is increasingly distributed across algorithmic systems, digital platforms, and human–AI interactions. At the same time, the automation of learning processes through generative AI, adaptive systems, and data-driven models has shifted educational practices toward efficiency and personalization, while raising concerns about reduced critical engagement and epistemic depth. Furthermore, the emergence of probabilistic, opaque, and data-driven knowledge systems challenges traditional epistemological assumptions and necessitates new competencies, including AI literacy, critical evaluation, and ethical awareness. Therefore, this study affirms that a comprehensive reconfiguration of educational epistemology is essential, emphasizing the alignment of technological innovation with human-centered values, critical thinking, and epistemic justice to ensure that education remains meaningful, reflective, and socially responsible in the AI era.

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