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Posted Date: 7 January 2026

doi: 10.20944/preprints202601.0498.v1

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Article

Sustainable Education in the Age of Artificial Intelligence and Digitalization: A Value-Critical Approach

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Abstract

The rapid expansion of artificial intelligence (AI) and digitalization in contemporary education has reshaped global debates on sustainable education, often emphasizing efficiency, personalization, and technological innovation. However, this transformation has coincided with increasing technologization and commodification of education, raising critical questions about whether AI-driven education can genuinely support sustainability as a value-based and human-centered project. This study examines sustainable education in the age of artificial intelligence and digitalization through a value-critical analytical approach grounded in a conceptual distinction between sustainable education, sustainability in education, and education for sustainable development. Methodologically, the article adopts a qualitative critical analysis of contemporary literature and policy-oriented debates to assess the ethical, social, and educational implications of AI integration. The analysis reveals a dual and context-dependent impact of AI on sustainable education: while AI can enhance educational quality, access, and personalization in well-resourced and well-governed contexts, it may also intensify educational inequalities, reinforce the commodification of knowledge, undermine academic integrity, and marginalize the human dimension of education under market-driven and weakly regulated conditions. These challenges are particularly evident in culturally and religiously grounded educational contexts, where AI reshapes epistemic authority and educational meaning. The study concludes that achieving sustainable education in the digital age depends not on AI adoption per se, but on reframing AI and digitalization within a coherent ethical and value-based framework that subordinates technology to educational aims, social justice, and human dignity.

Keywords: sustainable education; artificial intelligence in education; digitalization; Educational ethics; value-based education; commodification of education; educational equity

1. Introduction

The rapid expansion of artificial intelligence (AI) and digitalization has become one of the most influential transformations shaping contemporary education worldwide. Digital technologies increasingly mediate teaching, learning, assessment, and institutional governance, while AI-driven systems are being integrated into classrooms, online platforms, and educational management structures. Within global policy agendas, particularly those related to the United Nations Sustainable Development Goals, education is widely framed as a key driver of sustainable development, with Sustainable Development Goal 4 emphasizing inclusive, equitable, and quality education for all [3,4]. In this context, AI is often presented as a technological catalyst capable of modernizing education systems and aligning them with sustainability objectives.

Despite this optimistic framing, the growing reliance on AI and digitalization raises fundamental questions about the meaning of sustainability in education. Technological innovation is frequently equated with progress, efficiency, and improvement, yet such assumptions risk obscuring the normative and human dimensions of education. Education is not merely a technical system to be

optimized, but a value-laden social institution concerned with human development, equity, and ethical responsibility. As AI-driven technologies increasingly shape educational practices and policies, it becomes crucial to examine whether their adoption genuinely supports sustainable education or whether it contributes to the technologization and commodification of learning under market-driven logics.

A key conceptual contribution to this debate is provided by Alam, who offers a clear analytical distinction between sustainable education, sustainability in education, and education for sustainable development [1]. While sustainability in education often focuses on institutional durability, efficiency, and system continuity, sustainable education is framed as a fundamentally value-based and human-centered project oriented toward social justice, equity, and long-term ethical aims. Education for sustainable development, in contrast, typically emphasizes curricular and pedagogical alignment with sustainability goals. Alam argues that the failure to maintain these distinctions has generated conceptual ambiguity in educational research and policy, allowing technologization to be presented as a proxy for sustainability rather than as a means that must itself be critically evaluated [1].

Within the existing research field, a substantial body of literature highlights the potential benefits of AI in education. Empirical studies and reviews suggest that AI-powered learning systems can enhance personalization, adaptive feedback, learner engagement, and institutional efficiency when implemented under favorable conditions [3,5]. From this perspective, AI is viewed as a tool capable of improving educational quality and supporting sustainability goals, particularly in well-resourced contexts with strong governance structures [4,5]. These studies often emphasize the capacity of AI to optimize learning processes, reduce administrative burdens, and expand access to educational opportunities.

In contrast, a growing body of critical scholarship challenges the assumption that AI-driven education is inherently sustainable. Alam's analysis of internationalization and commodification in higher education demonstrates how technological expansion is frequently embedded within market-oriented governance frameworks that prioritize competitiveness, efficiency, and profitability [2]. From this perspective, AI may reinforce the commodification of education by transforming learning processes, institutional practices, and student data into economic assets. This line of research highlights a fundamental controversy within the field: whether AI serves as an instrument for educational empowerment or as a mechanism that sustains market-driven models at the expense of educational values [2].

Educational equity and ethics represent central points of contention in debates on AI and sustainable education. Research indicates that students from low-income, rural, and marginalized backgrounds often benefit less from AI-based educational technologies due to disparities in digital infrastructure, access to devices, and institutional capacity [6,7]. Rather than functioning as equalizers, AI systems may therefore reproduce or intensify existing inequalities. Ethical concerns further complicate this picture, including issues related to data privacy, surveillance, algorithmic bias, transparency, and academic integrity [8–11]. These challenges raise serious questions about whether education mediated by AI can remain aligned with the ethical foundations of sustainability.

The tensions surrounding AI and sustainable education become particularly visible in culturally and religiously grounded educational contexts, where education is closely linked to value formation, epistemic authority, and moral development. Studies in Islamic educational settings suggest that AI integration may commodify knowledge, weaken traditional forms of scholarly authority, and reshape the meaning and purpose of education itself [12,13]. These contexts reveal that sustainability cannot be assessed solely through technical performance indicators, but must be evaluated in relation to cultural coherence, ethical commitments, and the human purposes of learning. Such perspectives remain underrepresented in mainstream AI-in-education research, despite their analytical significance.

Against this background, the present study examines sustainable education in the age of artificial intelligence and digitalization through a value-critical analytical approach grounded in

Alam's conceptual framework [1,2]. The main aim of this work is to assess whether—and under what conditions—AI can support sustainable education as a human-centered and value-based project rather than reducing education to a technologically optimized and commodified service. The study advances the principal conclusion that AI neither inherently promotes nor undermines sustainable education. Instead, its impact is fundamentally context-dependent, shaped by governance structures, ethical frameworks, and underlying educational values. Achieving sustainable education in the digital age therefore requires subordinating AI and digitalization to clearly articulated commitments to social justice, human dignity, and the public good.

It is important to clarify that this study does not seek to provide a systematic literature review, bibliometric analysis, or empirical evaluation of specific artificial intelligence applications in educational settings. Instead, it adopts a qualitative, conceptual, and value-critical analytical approach aimed at examining the normative assumptions, ethical tensions, and governance conditions that shape contemporary debates on AI, digitalization, and sustainable education. The focus of the analysis is therefore interpretive and theoretical, rather than empirical or intervention-based.

The introduction should briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be carefully reviewed and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work and highlight the principal conclusions. As far as possible, please keep the introduction comprehensible to scientists outside your particular field of research. References should be numbered in order of appearance and indicated by a numeral or numerals in square brackets—e.g., [1] or [2,3], or [4–6]. See the end of the document for further details on references.

This study contributes by advancing a value-critical framework that reconceptualizes AI not as a driver of sustainability, but as a contingent instrument subordinated to educational ethics and human dignity.

2. Related Literature and Theoretical Background

2.1. Conceptualizing Sustainable Education in an Era of Technologization

Recent scholarship has increasingly emphasized the need to distinguish conceptually between sustainable education, sustainability in education, and education for sustainable development, particularly in the context of accelerating digitalization and artificial intelligence (AI) integration. Alam [1,2] provides one of the most systematic conceptual frameworks in this regard, arguing that sustainable education should not be reduced to institutional efficiency, technological optimization, or market-oriented performance indicators. Rather, it constitutes a value-based and human-centered educational paradigm oriented toward long-term intellectual, ethical, and social development.

Within this framework, AI and digital technologies are not inherently antithetical to sustainable education; however, their educational value depends on how they are embedded within broader ethical, social, and pedagogical goals. Alam [1] cautions that the technologization of education often leads to conceptual slippage, where sustainability is conflated with innovation, scalability, or international competitiveness, thereby obscuring the normative foundations of education itself. This critique provides a crucial theoretical lens for assessing contemporary AI-driven educational reforms.

2.2. Artificial Intelligence and Sustainability in Education: Enabling Potentials

A significant strand of the literature highlights the potential of AI to support sustainability goals in education, particularly in relation to access, personalization, and learning efficiency. Several studies emphasize AI's capacity to enhance educational quality through adaptive learning systems, real-time feedback, and data-driven curriculum design, aligning these developments with SDG 4 (Quality Education) [3–6].

Empirical and bibliometric analyses suggest that AI-driven platforms can improve learner engagement, facilitate self-directed learning, and support diverse educational needs, especially in higher education contexts [4,7]. In well-resourced settings, AI has been associated with improved academic performance, reduced learning anxiety, and enhanced communication skills [8]. These findings underpin an optimistic narrative in which AI functions as a catalyst for educational innovation and sustainability.

However, even within this enabling discourse, several authors stress that positive outcomes are highly context-dependent and contingent upon adequate infrastructure, institutional capacity, and professional development for educators [5,9]. This conditionality challenges deterministic assumptions that technological adoption alone guarantees sustainable educational outcomes.

2.3. Critical Perspectives: Commodification, Market Logic, and Educational Governance

Alongside optimistic accounts, a growing body of critical literature interrogates the structural implications of AI integration in education, particularly its role in reinforcing market logics and the commodification of knowledge. Alam [2] argues that the internationalization and digital transformation of education have intensified the treatment of education as an economic commodity, where efficiency, scalability, and data extraction increasingly overshadow educational values.

Several studies echo this concern by highlighting how AI-driven platforms transform student data into commercial assets, raising questions about ownership, surveillance, and institutional accountability [10–13]. From this perspective, AI is not a neutral tool but an embedded socio-technical system shaped by corporate interests, platform capitalism, and governance asymmetries. Without robust regulatory frameworks, AI deployment risks subordinating educational aims to economic imperatives, thereby undermining the normative foundations of sustainable education.

2.4. Ethical Challenges and Educational Equity

Ethical concerns constitute one of the most extensively discussed themes in the literature on AI in education. Data privacy, algorithmic bias, transparency, and academic integrity are recurrent issues across diverse geographical and institutional contexts [11,14–17]. Studies report that AI systems may reproduce existing social inequalities through biased datasets, opaque decision-making processes, and uneven access to digital resources.

The digital divide emerges as a structural barrier to equitable AI adoption. Research indicates that students from low-income and rural backgrounds exhibit significantly lower engagement with AI-based learning technologies due to infrastructural constraints and limited digital literacy [6,8,18]. These disparities suggest that AI may exacerbate, rather than mitigate, educational inequalities unless equity-oriented design and governance mechanisms are deliberately implemented.

Academic integrity represents another major ethical tension. The widespread use of generative AI tools has raised concerns regarding plagiarism, authorship, and the erosion of critical thinking skills [15,19]. While AI can support learning, unregulated use risks transforming education into a transactional process oriented toward output rather than intellectual formation.

2.5. Cultural and Value-Based Dimensions of AI in Education

A comparatively underexplored but increasingly salient dimension of the literature concerns the interaction between AI and culturally or religiously grounded educational contexts. Several studies focusing on Islamic and value-based education highlight how AI challenges traditional epistemic authority, pedagogical relationships, and the moral meaning of knowledge [16,20].

In these contexts, AI is not merely a technological innovation but an epistemological intervention that reshapes how knowledge is produced, transmitted, and legitimized. Concerns about the commodification of sacred knowledge, the displacement of teacher authority, and tensions between efficiency-driven AI systems and contemplative educational traditions underscore the need for context-sensitive and value-critical approaches to AI integration.

2.6. Synthesis and Research Gap

Synthesizing the existing literature reveals a persistent duality: AI is simultaneously framed as a tool for enhancing educational sustainability and as a mechanism that may undermine it through commodification, inequality, and ethical erosion. While substantial research has examined AI's technical applications and short-term educational outcomes, fewer studies have systematically addressed sustainable education as a normative and value-based project in the age of AI.

In particular, there remains a lack of integrative frameworks that reconcile AI-driven digitalization with ethical values, social justice, and human dignity across diverse educational contexts. Building on the conceptual distinctions articulated by Alam [1,2] and informed by recent empirical and critical studies, the present article addresses this gap by advancing a value-critical analysis of sustainable education in the age of artificial intelligence and digitalization.

3. Conceptual Framework and Analytical Approach

3.1. Conceptual Foundations of the Study

This study adopts a value-critical conceptual framework to examine sustainable education in the age of artificial intelligence (AI) and digitalization. The framework is grounded in the analytical distinctions articulated by Alam between sustainable education, sustainability in education, and education for sustainable development [1,2]. These distinctions are not merely terminological, but reflect fundamentally different normative orientations toward the aims, values, and social functions of education.

Within this framework, sustainability in education is understood as a system-oriented approach that prioritizes institutional continuity, efficiency, and adaptability under conditions of technological and economic change. Education for sustainable development, by contrast, focuses on curricular and pedagogical initiatives that promote awareness of sustainability-related goals. Sustainable education, however, constitutes the most comprehensive and normatively demanding concept, as it situates education itself as a value-based and human-centered project oriented toward long-term intellectual, ethical, and social flourishing [1].

This study adopts sustainable education as its primary analytical lens. Doing so enables a critical evaluation of AI not solely in terms of functional performance or innovation capacity, but in relation to broader educational values, including equity, human dignity, epistemic integrity, and social responsibility.

3.2. Artificial Intelligence as a Socio-Technical and Normative System

Rather than treating AI as a neutral technological tool, this study conceptualizes AI as a socio-technical system embedded within specific economic, institutional, and cultural contexts. AI-driven educational technologies shape not only instructional practices, but also governance structures, assessment regimes, and forms of epistemic authority. As Alam argues, technological systems introduced under market-driven and internationalized educational models tend to reflect and reinforce prevailing power relations and economic priorities [2].

From this perspective, AI integration in education entails normative consequences that extend beyond technical efficiency. Decisions concerning data collection, algorithmic design, platform governance, and institutional adoption implicitly encode values related to control, accountability, and the commodification of knowledge. The conceptual framework therefore rejects technologically deterministic narratives and instead emphasizes the contextual and value-laden nature of AI-mediated education.

3.3. Analytical Dimensions

To operationalize this conceptual framework, the study analyzes AI and digitalization in education across four interrelated analytical dimensions:

(1) Educational Purpose and Meaning.

This dimension examines how AI reshapes the perceived aims of education, including tensions between education as a process of human formation and education as a system optimized for performance, efficiency, and measurable outputs.

(2) Equity and Social Justice.

This dimension assesses whether AI integration contributes to or undermines educational equity by examining issues related to access, digital divides, and the differential impact of AI systems across social and institutional contexts.

(3) Ethical and Epistemic Integrity.

Here, the analysis focuses on data ethics, algorithmic bias, academic integrity, and the transformation of epistemic authority in AI-mediated learning environments. This includes consideration of how AI affects authorship, assessment, and the credibility of knowledge production.

(4) Governance and Commodification.

This dimension evaluates the role of market logic, platform capitalism, and institutional governance in shaping AI adoption. It critically examines whether AI reinforces the commodification of education or can be subordinated to public-oriented and value-based educational goals.

Together, these dimensions provide an integrated analytical structure through which the sustainability of AI-driven education can be assessed beyond purely technical criteria.

3.4. Analytical Approach

Methodologically, the study employs a qualitative critical analysis of contemporary academic literature, policy-oriented discussions, and conceptual debates on AI, digitalization, and sustainable education. Rather than aggregating empirical findings, the analysis synthesizes insights across disciplines to identify underlying assumptions, normative tensions, and conceptual gaps.

This analytical approach is explicitly interpretive and normative. It does not seek to measure the effectiveness of specific AI applications, but to evaluate the conditions under which AI can align with or undermine sustainable education as a value-based project. By integrating conceptual analysis with critical interpretation, the study aims to illuminate how AI may be reoriented toward ethical, equitable, and human-centered educational futures.

3.5. Positioning of the Study

By combining Alam's conceptual distinctions with a multidimensional critical analysis of AI in education, this framework positions the study at the intersection of educational theory, ethics, and digital transformation. It contributes to existing scholarship by shifting the focus from technological capability to normative alignment, emphasizing that sustainable education in the digital age depends not on AI adoption per se, but on the ethical and value-based frameworks that govern its use.

4. Materials and Methods

4.1. Research Design

This study adopts a qualitative, conceptual, and critical research design aimed at examining sustainable education in the age of artificial intelligence (AI) and digitalization from a value-based perspective. Rather than producing empirical measurements or experimental outcomes, the research seeks to analyze underlying concepts, normative assumptions, and ethical tensions that shape contemporary debates on AI-driven education. This design is particularly suitable for addressing questions related to educational values, social justice, and human-centered sustainability, which cannot be adequately captured through purely quantitative or interventional methods.

4.2. Materials and Data Sources

The materials used in this study consist of peer-reviewed academic literature, including conceptual, theoretical, and empirical studies published in international journals, with particular emphasis on recent scholarship addressing AI, digitalization, sustainability, and education. Special attention is given to works published in Sustainability and related interdisciplinary journals that engage with sustainable education, educational ethics, and technological governance.

In addition to academic literature, the analysis draws on policy-oriented discussions and normative frameworks related to sustainable development, educational equity, and digital transformation. No proprietary datasets, restricted materials, or confidential sources were used. All materials analyzed in this study are publicly available, ensuring transparency and replicability.

4.3. Analytical Procedure

The analytical process followed a structured qualitative critical analysis comprising three interrelated stages:

Conceptual Mapping:

Key concepts—such as sustainable education, sustainability in education, digitalization, commodification, equity, and ethical governance—were identified and mapped across the literature to clarify their meanings and interrelations.

Thematic Analysis:

The selected literature was examined to identify recurring themes, dominant narratives, and points of divergence regarding the role of AI in education. Particular attention was paid to tensions between enabling and critical perspectives, especially in relation to equity, ethics, and market-driven educational models.

Normative Evaluation:

Drawing on value-based educational theory, the study critically assessed the implications of AI integration for educational purpose, human dignity, epistemic integrity, and social justice. This evaluative stage enabled the development of an integrated analytical framework rather than a descriptive summary of existing studies.

This procedure allows other researchers to replicate the analytical approach by applying the same stages of conceptual mapping, thematic synthesis, and normative evaluation to alternative datasets or educational contexts.

4.4. Ethical Considerations

This research does not involve human participants, animals, personal data, or experimental interventions. Consequently, ethical approval from an institutional review board was not required. Nevertheless, the study adheres to established principles of academic integrity, including accurate representation of sources, critical engagement with existing scholarship, and transparency in methodological choices.

4.5. Use of Generative Artificial Intelligence

Generative artificial intelligence tools were used solely for language refinement and editorial assistance, including grammar checking, stylistic improvement, and formatting support. GenAI was not used to generate original data, analytical arguments, conceptual frameworks, or interpretive conclusions. All intellectual content, analytical judgments, and normative positions presented in this article are the sole responsibility of the authors.

5. Results

This section presents the main analytical results derived from the qualitative critical analysis of contemporary literature and the conceptual framework developed in this study. Rather than reporting experimental or statistical findings, the results articulate a set of conceptual and normative

insights concerning the relationship between artificial intelligence (AI), digitalization, and sustainable education, as commonly practiced in theory-driven educational research [1,2].

5.1. Dual Impact of Artificial Intelligence on Sustainable Education

The analysis reveals a dual and context-dependent impact of AI on sustainable education. On the one hand, AI-driven technologies demonstrate significant potential to support educational sustainability when deployed within ethically grounded, well-governed, and resource-adequate contexts [3–5]. On the other hand, under market-driven and weakly regulated conditions, AI tends to undermine key dimensions of sustainable education by reinforcing instrumental and efficiency-oriented educational models [1,2,6].

These results confirm that AI does not exert a uniform influence on education. Rather, its effects are mediated by institutional priorities, governance frameworks, and underlying educational values [2,7].

5.2. AI-Enabled Contributions to Educational Sustainability

In contexts characterized by strong institutional capacity and normative oversight, AI contributes positively to several dimensions of educational sustainability. The analysis identifies the following enabling outcomes:

- Enhanced personalization of learning pathways, allowing greater responsiveness to diverse learner needs [4,8];
- Improved access to educational resources through digital platforms and adaptive systems [5,9];
- Increased instructional efficiency, reducing administrative burdens on educators [6,10];
- Support for self-directed and lifelong learning models [3,11].

These outcomes primarily align with sustainability in education rather than sustainable education in its normative sense, as their long-term value remains contingent upon ethical orientation and pedagogical purpose [1,2].

5.3. Risks of Commodification and Value Erosion

A central analytical result concerns the reinforcement of commodification processes in AI-driven educational environments. The findings indicate that AI technologies are frequently embedded within institutional frameworks prioritizing efficiency, scalability, and international competitiveness, thereby reframing education as a marketable service rather than a formative human practice [2,6,12].

Key risks identified include:

The reduction of educational success to measurable outputs and performance indicators [6,13];

The transformation of student data into economic assets within platform-based educational systems [10,12];

The marginalization of relational, ethical, and reflective dimensions of education [1,14];

The subordination of educational values to institutional branding, rankings, and market visibility [2].

These dynamics directly challenge the normative foundations of sustainable education, particularly its commitment to human dignity and long-term social development [1,2].

5.4. Implications for Educational Equity and Social Justice

The analysis further reveals that AI integration tends to amplify existing educational inequalities rather than mitigate them. Unequal access to AI-enhanced learning environments persists across regions, institutions, and social groups due to disparities in infrastructure, digital literacy, and financial resources [5,8,15].

The following equity-related patterns emerge:

- Unequal access to AI-supported learning tools between high-income and low-income educational contexts [9,15];
- Differential institutional capacity to regulate, govern, and ethically oversee AI systems [2,7];
- Increased vulnerability of marginalized learners to algorithmic bias, exclusion, and misclassification [11,16].

These findings indicate that unregulated AI adoption risks contradicting the social justice objectives central to sustainable education [1,3].

5.5. Ethical and Epistemic Consequences of AI in Education

Another significant result concerns the ethical and epistemic implications of AI-mediated education. The analysis highlights growing tensions related to academic integrity, epistemic authority, and the meaning of knowledge production in digital learning environments [14,17].

AI-driven automation of assessment, content generation, and feedback mechanisms raises concerns regarding:

- The erosion of critical thinking, intellectual autonomy, and deep learning practices [11,17];
- Ambiguities surrounding authorship, originality, and responsibility for knowledge production [16,18];
- The displacement or weakening of educators' epistemic and moral authority [2,14].

These challenges are particularly salient in culturally and religiously grounded educational contexts, where education is closely linked to moral formation and value transmission [1,19].

5.6. Reframing AI within a Value-Based Educational Paradigm

Synthesizing these results, the study finds that the sustainability of AI-driven education depends not on technological sophistication alone, but on normative framing, ethical governance, and value-based orientation [1–3]. Sustainable education in the digital age emerges only when AI is explicitly subordinated to educational aims grounded in human dignity, social justice, and epistemic integrity.

Accordingly, the principal conclusion drawn from the analysis is that AI should be approached as a means rather than an end within sustainable education. Without a coherent value-based framework, AI risks accelerating processes of commodification and inequality that undermine the very sustainability it is often claimed to promote [1,2].

6. Discussion

This section discusses the analytical results in relation to existing scholarship on artificial intelligence (AI), digitalization, and sustainable education. The findings are interpreted through the value-critical conceptual framework adopted in this study, with particular attention to how AI-mediated educational transformations align with or diverge from the normative aims of sustainable education.

6.1. Interpreting the Dual Role of AI in Sustainable Education

The results confirm that AI plays a dual and context-dependent role in contemporary education, a conclusion that resonates with previous studies reporting both enabling and disruptive effects of educational technologies [3–6]. While much of the existing literature emphasizes the efficiency-enhancing and personalization capacities of AI, the present analysis demonstrates that such benefits remain structurally contingent upon governance quality, institutional priorities, and ethical orientation.

This finding challenges technologically deterministic assumptions that portray AI as an inherently progressive force in education. Instead, it supports critical perspectives arguing that AI amplifies prevailing educational logics rather than transforming them by default [2,6]. From the standpoint of sustainable education, this implies that technological innovation alone is insufficient;

what matters is whether AI adoption is normatively aligned with human-centered educational purposes.

6.2. Sustainable Education versus Instrumental Sustainability

A key interpretive contribution of this study lies in distinguishing between outcomes associated with sustainability in education and those genuinely advancing sustainable education. The results indicate that many AI-enabled improvements—such as efficiency gains, scalability, and performance optimization—correspond primarily to system sustainability rather than to the deeper educational values emphasized in sustainable education theory [1,2].

This distinction helps explain why AI-driven reforms often succeed in improving operational metrics while simultaneously generating concerns about commodification, value erosion, and depersonalization. By foregrounding this conceptual differentiation, the study clarifies a persistent ambiguity in the literature and demonstrates how sustainability discourse can obscure normative trade-offs when technological performance is treated as an end in itself.

6.3. Commodification, Governance, and Market Logics

The discussion of commodification extends and reinforces earlier critiques of the marketization of higher education [2,12]. The results suggest that AI functions as a catalyst rather than a cause of commodification processes, accelerating trends already embedded in internationalized and competitive educational systems.

From a governance perspective, this implies that ethical risks associated with AI—such as data exploitation, algorithmic opacity, and performance-driven assessment—cannot be addressed solely through technical safeguards. Instead, they require institutional and policy-level interventions capable of subordinating AI systems to public educational values rather than commercial imperatives. This interpretation aligns with calls for stronger regulatory frameworks and value-sensitive design in educational technologies [10,14].

6.4. Equity, Ethics, and Epistemic Integrity

The findings concerning educational equity and ethical integrity echo a growing body of research highlighting the uneven distribution of AI benefits and risks [8,15,16]. The amplification of digital divides and algorithmic biases observed in this study underscores the inadequacy of access-based solutions that focus narrowly on technological availability without addressing structural inequalities.

Moreover, the ethical and epistemic challenges identified—particularly those related to academic integrity, authorship, and the authority of educators—raise fundamental questions about the future of knowledge production in AI-mediated learning environments [17,18]. These concerns are especially salient in value-based and culturally grounded educational contexts, where education is inseparable from moral formation and epistemic responsibility. The results thus support calls for integrating ethical reasoning and epistemic accountability into AI governance frameworks.

6.5. Implications for Policy and Educational Practice

Interpreted in a broader context, the results suggest that sustainable education in the digital age requires a reorientation of policy priorities. Rather than focusing primarily on innovation, efficiency, or competitiveness, educational policies should emphasize ethical governance, equity, and the preservation of human-centered pedagogical relationships.

For educational practice, this implies that AI should be deployed as a supportive instrument that enhances, rather than replaces, reflective teaching and learning processes. Educators and institutions must remain central agents in shaping how AI is used, ensuring that technological tools serve clearly articulated educational aims.

6.6. Limitations and Directions for Future Research

As a conceptual and qualitative study, this research does not provide empirical measurement of AI's educational impacts across specific contexts. Future research could complement the present analysis through comparative case studies, policy evaluations, or empirical investigations examining how value-based AI governance is implemented in practice.

Further studies may also explore culturally and religiously grounded educational settings in greater depth, as these contexts offer critical insights into the interaction between AI, epistemic authority, and moral education. Such research would contribute to developing more context-sensitive models of sustainable education in an increasingly digital world.

From a policy perspective, the findings of this study suggest that the contribution of artificial intelligence to sustainable education depends fundamentally on governance frameworks rather than on technological adoption alone. Educational policymakers and institutional leaders should therefore prioritize the development of regulatory and ethical guidelines that explicitly subordinate AI systems to educational values, social justice objectives, and human dignity. This includes establishing transparent standards for data governance, accountability mechanisms for algorithmic decision-making, and equity-oriented policies that address digital divides across institutions and learner populations. Without such normative and regulatory safeguards, AI risks reinforcing commodification and inequality, thereby undermining the very sustainability goals it is often claimed to advance.

7. Conclusions

This study has examined sustainable education in the age of artificial intelligence (AI) and digitalization through a value-critical analytical lens. By distinguishing conceptually between sustainable education, sustainability in education, and education for sustainable development, the article has demonstrated that contemporary debates on AI-driven education often conflate technological efficiency with educational sustainability, thereby obscuring essential normative considerations.

The analysis shows that AI exerts neither an inherently positive nor inherently negative influence on education. Rather, its impact is fundamentally shaped by the ethical, institutional, and governance frameworks within which it is embedded. While AI can enhance access, personalization, and instructional efficiency in well-regulated and value-oriented contexts, it may also intensify commodification, inequality, and epistemic erosion when subordinated to market-driven logics and weak regulatory environments.

The principal contribution of this study lies in reframing AI and digitalization as means rather than ends within sustainable education. Sustainable education in the digital age emerges not from technological adoption alone, but from the subordination of AI to educational purposes grounded in human dignity, social justice, and epistemic integrity. This perspective challenges technocratic and instrumental narratives that portray innovation as a sufficient condition for sustainability.

From a broader standpoint, the findings underscore the need for educational policies and institutional practices that prioritize ethical governance, equity, and the preservation of human-centered pedagogical relationships. AI should be designed and implemented in ways that support reflective learning, critical thinking, and moral formation, rather than reducing education to data-driven performance optimization.

Finally, this study highlights the importance of continued interdisciplinary research on the normative dimensions of AI in education. Future work integrating empirical analysis with ethical and cultural perspectives will be essential for developing context-sensitive models of sustainable education capable of addressing the complex challenges of an increasingly digitalized world.

Author Contributions: Conceptualization, F.A.A. and A.O.A.; methodology, F.A.A. and A.O.A.; formal analysis, F.A.A.; investigation, F.A.A. and A.O.A.; writing—original draft preparation, F.A.A.; writing—review and editing, F.A.A. and A.O.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments: During the preparation of this manuscript, the author used generative artificial intelligence tools for language refinement and conceptual organization. The author reviewed, edited, and takes full responsibility for the content of this publication.

Conflicts of Interest: The author declares no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AI Artificial Intelligence

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