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Abstract

This paper offers a literature synthesis on the role of artificial intelligence (AI) as a strategic policy instrument in tackling the challenges of Teaching and Learning (TL) within the Ghanaian educational context. By examining the current state and prospects of AI in education (AIEd), specifically in Ghana, this study highlights how AI can address unique educational challenges faced by Ghanaian students and educators. It adopts the dual instructor (AI and Human) model as a conceptual lens to examine how AI can revolutionize TL methodologies, thereby equipping learners for an AI-centric future. Our findings suggest that AI holds considerable promise for enhancing student engagement, personalizing learning experiences, increasing educator efficiency, and improving administrative processes. However, fully harnessing AI's potential in education requires a strategic, contextually sensitive approach that addresses Ghana's distinct cultural, economic, and infrastructural realities. Furthermore, integrating AIEd initiatives with overarching educational objectives is essential to maximize teaching effectiveness, student involvement, and administrative productivity. By adopting a strategic, informed, and collaborative methodology and implementing the suggested recommendations, Ghana can leverage AI to significantly upgrade its educational framework, better prepare its students for future challenges, advance its educational and developmental ambitions, and ensure AI deployment is equitable, ethical, and impactful. This study contributes to the emergent discourse on AIEd in Ghana and other similar contexts, highlighting the need for strategic policy implementations.

Keywords

policy, artificial intelligence in education, AI-human model, teaching, learning

Revisions

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Artificial Intelligence as a Policy Response to Teaching and Learning Issues in Education in Ghana

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This paper offers a literature synthesis on the role of artificial intelligence (AI) as a strategic policy instrument in tackling the challenges of Teaching and Learning (TL) within the Ghanaian educational context. By examining the current state and prospects of AI in education (AIEd), specifically in Ghana, this study highlights how AI can address unique educational challenges faced by Ghanaian students and educators. It adopts the dual instructor (AI and Human) model as a conceptual lens to examine how AI can revolutionize TL methodologies, thereby equipping learners for an AI-centric future. Our findings suggest that AI holds considerable promise for enhancing student engagement, personalizing learning experiences, increasing educator efficiency, and improving administrative processes. However, fully harnessing AI's potential in education requires a strategic, contextually sensitive approach that addresses Ghana's distinct cultural, economic, and infrastructural realities. Furthermore, integrating AIEd initiatives with overarching educational objectives is essential to maximize teaching effectiveness, student involvement, and administrative productivity. By adopting a strategic, informed, and collaborative methodology and implementing the suggested recommendations, Ghana can leverage AI to significantly upgrade its educational framework, better prepare its students for future challenges, advance its educational and developmental ambitions, and ensure AI deployment is equitable, ethical, and impactful. This study contributes to the emergent discourse on AIEd in Ghana and other similar contexts, highlighting the need for strategic policy implementations.

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Introduction

Education in Ghana faces persistent challenges in quality, access, and participation. The educational structure, encompassing basic, secondary, and tertiary levels, grapples with multifaceted issues, particularly in teaching and learning (TL; Atuahene & Owusu-Ansah, 2013; Nunoo et al., 2023; Mantey, 2017). These issues hamper the development of critical thinking and innovation among students (Peacefmonline, 2022; Reigeluth et al., 2017). The Ghana Education Minister expressed this concern, emphasizing that the current education system cannot transform Ghana or produce "critical

thinking individuals, especially as we are in the 21st Century, Education 4.0, the fourth industrial revolution" (Peacefmonline, 2022, para. 4). This highlights the urgency of leveraging AI technologies to enhance educational practices and outcomes in Ghana. Artificial intelligence (AI) in education (AIEd) is posited as a transformative tool to overcome these challenges by enhancing TL methods and contributing to Sustainable Development Goal (SDG) 4 (Baker & Smith, 2019; Holmes et al., 2019; Miao et al., 2021). Paek & Kim (2021) analyzed worldwide research trends on the impact of AIEd and found that the number of papers on AIEd has steadily increased over the past 20 years, with a dramatic rise since 2015. The widespread adoption of AIEd, accelerated by the COVID-19 pandemic's impact on education, reshapes global educational practices and priorities, emphasizing the need for adaptive learning and on-the-job skills (Du Boulay, 2024; Roll & Wylie, 2016). Its integration into educational methodologies marks a shift towards more interactive, personalized, and efficient learning experiences.

Governments are publishing national AIEd strategies, aiming to capitalize on AIEd technological opportunities while addressing challenges. Most of the over 300 AI policies from 60 nations emphasize education (Miao et al., 2021), with academic institutions, civil society organizations, and the private sector demonstrating their commitment to leading appropriate policy responses. These responses are aimed at integrating AIEd for innovative TL, striving for equitable, high-quality education (UNESCO, 2019). In global expenditure on AIEd, China and the US account for more than half (Holmes et al., 2019). While international initiatives and policies increasingly focus on integrating AIEd (Miao et al., 2021; UNESCO, 2019), Ghana lags in research and application in this area (Amegadzie et al., 2021; Butakor, 2023). However, the role of evidence in policy processes, such as the government's adoption of new technologies, highlights the importance of integrating empirical evidence into decision-making processes (Amegadzie et al., 2021; Carter et al., 2023). Despite the limited application in Ghana, the widespread use of AIEd among students is particularly evident from the withholding of results from 235 schools during the 2023 West African Senior School Certificate Examination (WASSCE), which was attributed to the alleged use of AI-generated answers (Citinewsroom, 2023). The global progress in AIEd provides a reference point for understanding its potential impact in Ghana, where its implementation is still in the early stage (Amegadzie et al., 2021; Ampofo et al., 2023). Moreover, Schiff (2022) finds that global AI policy discussions in national AI policy strategies largely overlook the use of AIEd, focusing instead on the role of education in preparing an AI-ready workforce and training AI experts. This study delves into the current educational landscape in Ghana, explores the challenges, and posits the potential of AI as an innovative solution. It sets the stage for a discussion on how AI technologies can be leveraged to enhance the educational experience and outcomes.

Literature Review

The Role of AIEd

Evolution and Theoretical Foundations of AIEd

AI has revolutionized multiple sectors, with education being a prime area of transformation, particularly in developing countries like Ghana. Integrating AI into the Ghanaian educational system can provide personalized learning experiences and support educators in innovative ways that are tailored to the local context. The term *artificial intelligence* was coined by John McCarthy in 1956, marking the beginning of AI as a formal field of study (Miao et al., 2021). Its definition encompasses

systems capable of making decisions or predictions to achieve specific objectives (Gwagwa et al., 2020). Historical roots trace back to the 14th century with Ramon Llull's conceptualization of cognitive processes in machines, and Alan Turing's foundational work in the mid-20th century which established the computational principles and aspirations for AI (Cope et al., 2021 Humble & Mozelius, 2019). The application of AIEd dates to the 1970s, beginning with platforms like Scholar in 1970. These platforms explored how computer-assisted instruction could emulate the most effective one-on-one tutoring methods (Du Boulay, 2024; Holmes et al., 2019; Miao et al., 2021), leading to the proliferation of AIEd applications.

Advancements and Applications of AIEd

AIEd has evolved to encompass a variety of sophisticated technologies such as artificial neural networks, machine learning, deep learning, and genetic algorithms, driving the shift from traditional TL methods to more innovative and learner-centered approaches (Ouyang & Jiao, 2021). In Ghana, these advancements can address specific educational challenges such as teacher shortages, resource constraints, and the need for adaptive learning tools that cater to diverse student needs. Current AIEd applications include intelligent tutoring systems, virtual reality, intelligent robots, and AI-supported language learning, all aiming to enhance learning outcomes and personalize education (McArthur et al., 2005). These tools support a shift from teacher-centered to student-centered learning, exemplified by innovations like robotic interactive multimedia teaching methods (DW Documentary, 2019). AIEd's ability to analyze big data has led to the development of adaptive learning platforms, offering a unique and effective educational experience to every learner, regardless of the number of students, as if each one had their own personal tutor (Hashakimana & De Dieu Habyarimana, 2020; Holmes et al., 2019).

Benefits of AIEd

AIEd offers several advantages, such as personalized and collaborative learning experiences, and the ability to assist teachers in improving their practices (Onaolapo & Onifade, 2020; Roll & Wylie, 2016). Standardized assessments are common in education systems, often causing anxiety and influencing TL (Vincent-Lancrin & Van der Vlies, 2020). Employers and policymakers increasingly believe assessments should measure more than knowledge and reasoning, incorporating skills like problem-solving, collaboration, and social-emotional abilities, which are key in today's evolving work and societal contexts. AI is facilitating this shift, offering tools like embedded assessments for real-time evaluation and personalized feedback in digital learning environments, adapting to students' needs and tracking their progress (Vincent-Lancrin & Van der Vlies, 2020). In Ghana, these benefits are particularly significant as they can help bridge gaps in educational quality and access, enhance teacher effectiveness, provide students with tailored support that meets their individual learning needs, and prepare students for job market and national development. AIEd has been applied across system-facing, student-facing, and teacher-facing contexts, demonstrating versatility in enhancing educational outcomes, including curriculum customization, *predictive analytics, personalized learning, resource recommendations, and immediate feedback and assessment* (Baker & Smith, 2019; Chen et al., 2020; Miao et al., 2021).

Challenges and Concerns

Despite its benefits, the use of AIEd poses challenges for educators and policymakers, particularly regarding building trust in AI systems, impacts on traditional educational settings, and changes to teacher roles and professional identities (Edwards & Cheok, 2018; Miao et al., 2021; Vincent-Lancrin & Van der Vlies, 2020). These challenges have led to divergent responses from educational institutions, ranging from cautious adoption to outright bans (Sabzalieva & Valentini, 2023). Key issues include instructional methods, administrative frameworks, ethical considerations, equitable practices, educational standards, data privacy, long-term viability, and the potential for exacerbating biases, especially in developing countries (Citinewsroom, 2023; Fengchun et al., 2021; Gwagwa et al., 2020; Holmes et al., 2019; UNESCO, 2019). One particularly pressing concern is the problem of bias, which raises critical questions about promoting human-centered values, fairness, explainability, accountability, transparency, diversity, and neutrality in academic settings (Binns, 2018; Vincent-Lancrin & Van der Vlies, 2020). AIEd systems, often developed by individuals with inherent biases and/or using historically biased educational data, can perpetuate social inequities (Costanza-Chock, 2020). This bias, a growing concern in both public and academic discourse, presents a significant challenge, as AI can disproportionately affect those least able to contest its outcomes or influence its design (Costanza-Chock, 2020; Whittaker et al., 2018). In Ghana, these challenges are further compounded by infrastructural limitations, economic constraints, and cultural factors that influence the adoption and implementation of AI technologies in education. The ongoing debate between the AI-human (dual instructor) model and the AI-only instructor model underscores the tension between augmenting human educators versus replacing them (Miao et al., 2021; Newton & Newton, 2019). Moreover, the relevance of traditional educational institutions is increasingly being questioned as learning shifts outside formal settings, prompting a reevaluation of curricula and the integration of AI-related skills (Roll & Wylie, 2016; UNESCO, 2019).

The Current State and Future Prospects of AIEd in Ghana

The integration of AI in the Ghanaian education system is at a pivotal stage, with emerging research highlighting both its potential and the challenges it poses. This literature review synthesizes recent studies to provide insights into the current state and prospects of AIEd in Ghana.

Student and Educator Perspectives on AI

Educators and students in Ghana have expressed varying perspectives regarding AIEd, reflecting both enthusiasm for its potential and concerns about its implementation. Understanding these perspectives is crucial for developing AI solutions that are culturally and contextually relevant to the Ghanaian educational landscape. Nyabba & Zhai (2024) examined the outcomes of a professional development webinar designed to enhance teacher educators' understanding of Generative AI in Ghana. The study revealed varied familiarity with AI among participants, along with growing interest in its educational applications, such as automatic scoring, academic writing, and image generation, and a willingness to integrate AI tools into teaching practices. In addition, some participants in this study identified challenges like high costs, the need for training, and ethical concerns as barriers to AI use. Moreover, Adarkwah et al. (2023) and Nyaaba Akanzire et al. (2023) investigated Ghanaian academics' awareness and acceptance of AI tools. They found a generally positive attitude towards AI's potential to enhance educational practices but emphasize the need for comprehensive training and infrastructural development. This suggests a readiness to embrace AI, tempered by a recognition of

the need for supporting resources. Also, Butakor (2023) explored pre-service teachers' beliefs about AI in higher education at a university in Ghana. The study found that most pre-service teachers are aware of AI and believe it can positively impact their performance and serve as a substitute in a teacher's absence. However, despite recognizing AI's benefits, many expressed anxieties about using AI systems in their learning. Similarly, Mohammed (2023) studied early childhood educators' attitudes towards AI, noting concerns about human interaction, child privacy, and ethical considerations, thereby calling for a balanced approach to AI integration. Ofosu-Ampong et al. (2023) examined the trust, innovativeness, and psychological needs of students regarding AIEd. Their study reveals that students are inclined towards innovative AI tools, provided these tools meet their educational and psychological needs. This implies that the efficacy of AIEd partly depends on its alignment with student expectations and requirements.

AI in Specialized Education Fields

Specialized education fields such as diagnostic imaging and robotics have experienced the application of AIEd. Ampofo et al. (2023) focused on Ghanaian diagnostic imaging students' awareness of AI. They reported growing interest and positivity towards AI, alongside a need for curriculum updates and training. Similarly, Mills-Tettey et al. (2007) find that hands-on experience with robotics significantly enhances students' problem-solving skills and creativity, suggesting the value of practical AI applications in education.

Teaching Assistants and Employability Skills

AIEd has been identified as a potential teaching assistant and as a means to enhance employability skills in Ghana. Ghann (2020) discussed the deployment of AI as teachers in rural Ghana, acknowledging the potential to address teacher shortages but also highlighting significant infrastructure and training needs. Essel et al. (2022) evaluated the effectiveness of AI-powered chatbots in enhancing student learning. Their findings suggest that AI can provide a responsive learning environment, particularly beneficial in contexts with high student-to-teacher ratios. Segbenya et al. (2023) investigated AI's role in tertiary education, specifically its impact on employability skills. They noted a general openness among students to AI technologies but emphasized the importance of awareness and curriculum integration to prepare students for the evolving job market. Longe et al. (2021) discussed AI's potential to transform the global economy and emphasized the necessity of AI education for a future-ready workforce. This aligns with the larger vision of integrating AI into education, as seen in initiatives like Ashesi University, Ghana, which calls for innovative course designs in areas such as robotics and AI to support the development of technological innovation expertise in developing nations (Mills-Tettey et al., 2007).

Challenges and Opportunities in AIEd

Artificial intelligence in education, while offering numerous potentials, also presents various challenges and opportunities. Nsoh et al. (2023) reviewed the transformative potential of AIEd, particularly its role in facilitating adaptive learning and democratizing education. They highlight the challenges posed by the digital divide and emphasize the need for policies and infrastructure to support equitable AI integration. Suuk and Mwakideu (2023) report that legislators in Ghana are advocating for laws to regulate AI use. They are concerned that AI could exacerbate inequalities and seek clear guidelines for addressing machine errors. Amegadzie et al. (2021) highlighted the nascent

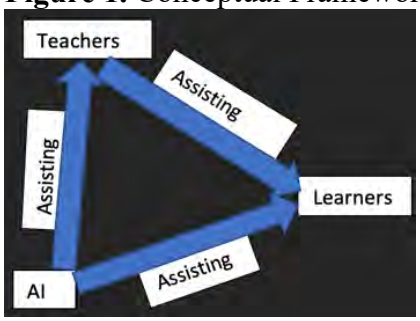
state of AIEd in Ghana, pointing out challenges like a lack of advanced facilities and limited practical application. The World Bank (2021) also points to the fact that, although Ghana does not have a national AI strategy, the government is investing in innovation through the National Entrepreneurship and Innovation Plan, promoting local AI skills hubs and conferences. The plan aligns with Ghana's 2012 Data Protection Act and aims to create a holistic approach to science, technology, and innovation (World Bank, 2021). Ghana boasts an internet penetration rate of 72% on average, according to Suuk and Mwakideu (2023), fostering a supportive and expanding digital landscape. According to Diplo (2023), Ghana is working with UN Global Pulse to develop local AI policy frameworks, including the Ethical Policy Frameworks for AI in the Global South, and is mapping its AI ecosystem for a national AI strategy. In summary, these studies collectively highlight the transformative potential of AI in improving education and employability in Ghana. They also draw attention to the challenges of equitable access, ethical considerations, and the need for a diverse AI workforce. The consensus underlines the need for enhanced AI literacy, infrastructure, and policy frameworks to fully leverage AI's benefits in the Ghanaian educational sector.

Conceptual Framework: AI-Human Model (Augmented Intelligence)

To ensure responsible application of AI in TL environments, there has been an initiative to foster ongoing collaboration between AI and educators. Miao et al. (2021) suggest rebranding AI as *augmented intelligence* to emphasize the synergistic relationship between humans and machines. This framework envisions AI tools enhancing human cognition and promoting a more collaborative intelligence distribution. The AI-human model, rooted in constructivist theory, envisions a shift from the traditional hierarchical teacher-student dynamic to a partnership where educators facilitate and learners actively engage and construct knowledge (Bodner, 1986; Fosnot, 2013). This model offers a roadmap for leveraging AI to address educational challenges, advocating for educators to transition from being mere knowledge transmitters to facilitators of learning.

We developed a diagram (see Figure 1) to illustrate the collaboration between AI and teachers in facilitating student learning. AI provides support for teachers in the teaching process, and together, they create an environment where students can reach their educational goals.

Figure 1. Conceptual Framework Graphic



Methods

Given that AIEd is an emerging concept in education, particularly within the Ghanaian context, this study adopts a qualitative research methodology through a literature synthesis. It aims to analyze various sources related to AIEd and its potential impacts in Ghana. This involves an examination of diverse materials, including reports, videos, documents, articles, news items, books, and other

relevant electronic media. The data from these sources were collected, organized, and analyzed to identify patterns, establish connections, and highlight recurring themes. The selection of literature sources was guided by specific inclusion and exclusion criteria to ensure relevance and quality. Included sources had to meet the following criteria: publications focusing on the integration of AIEd, specifically within the context of Ghana or similar developing countries; peer-reviewed articles, conference papers, government reports, and credible electronic media sources published within the last 20 years; sources addressing educational challenges and opportunities associated with AI, including case studies, empirical research, and theoretical analyses. Exclusion criteria were applied to filter out non-peer-reviewed articles, opinion pieces, and sources lacking empirical evidence; publications unrelated to educational technology or AI; sources published before the year 2000, unless they provided foundational theories or historical context critical to understanding the evolution of AIEd. The analysis of the references shows that over 90% are less than 10 years old. To identify patterns, establish connections, and highlight recurring themes in the selected literature, the following methods were utilized:

1. *Thematic Analysis*: This method involved coding the data to identify common themes and patterns. Each source was read multiple times to extract key themes related to the impact of AI on TL processes. Recurring themes such as personalized learning, teacher support, and administrative efficiency were noted and categorized.
2. *Content Analysis:* This method was used to quantify and analyze the presence of specific words, themes, or concepts within the texts. By systematically coding the data, the study was able to establish connections between different sources and highlight the frequency and significance of various themes.
3. *Comparative Analysis*: This approach compares findings across different studies to identify similarities and differences. It helped in establishing connections between various aspects of AI integration in education, such as technological infrastructure, cultural considerations, and economic challenges.
4. *Narrative Synthesis*: This method integrated findings from multiple sources to create a coherent narrative. It was particularly useful in summarizing how AI could address educational challenges in Ghana and proposing strategic policy recommendations.

The selected methods are well-supported by academic literature, justifying their appropriateness for this study. Thematic analysis is widely recognized for its ability to uncover deep insights from qualitative data (Braun & Clarke, 2006). Content analysis offers a systematic approach to analyzing text data and has been extensively used in educational research (Krippendorff, 2004). Comparative analysis helps in understanding the broader context by comparing different case studies (Ragin, 1987). Narrative synthesis is valuable for summarizing complex information from diverse sources (Popay et al., 2006). By employing these methods, the study ensured a robust and detailed analysis of the literature on AI's role in addressing TL challenges in Ghana.

Findings

Addressing Ghana's TL Challenges Through AI

Overview of Dominant Issues in TL Processes

The findings illuminate the intricate relationship between TL in Ghana, highlighting that challenges in one area invariably impact the other. This synthesis examines the interconnected nature of these issues, underscoring their combined effect on the educational experience.

Dominant Issues in Teaching Processes

Research reveals a troubling trajectory for Ghana, risking the achievement of SDG 4 due to poor educational outcomes. A significant number of students in Ghana are deprived of high-quality education, reflecting deep systemic failings (Nunoo et al., 2023). The root causes are multifaceted, including a high prevalence of unqualified teachers, poor attitude towards teaching, a threatening environment, and ineffective teaching methods, severely affecting educational quality (Annan, 2020; Appiahene et al., 2014). Instructors in inclusive and special schools lack the necessary training to teach students with special needs (Opoku et al., 2015). Structural impediments, such as overcrowded classrooms, and inadequate facilities, stifle learner-centered approaches (Mohammed & Amponsah, 2018). Inadequate school management has been found to result in high levels of teacher absenteeism, frequent instructional time losses, and low instructional quality (Nunoo et al., 2023). During the COVID-19 pandemic, these challenges were exacerbated, leading to widespread disruptions in education and highlighting deficiencies in remote teaching capabilities (Agormedah et al., 2020).

Challenges in Learning Processes

The effectiveness of learning in Ghana faces significant challenges due to a variety of factors. Many students are deprived of quality education because of overcrowded classrooms, a shortage of resources, and a lack of trained educators (Nunoo et al., 2023). According to UNICEF (n.d.), while access to education has improved in Ghana, many children still encounter barriers that prevent them from attending school or learning effectively. Overcrowded classrooms, inadequate facilities, and a shortage of trained teachers and educational resources continue to contribute to poor learning outcomes, as reflected in students' academic performance. The 2021 Population and Housing Census, as reported by the Ghana News Agency (2022), reveals that approximately 1.2 million children aged 4 to 17 in Ghana are not attending school, with nearly one million of them having never attended. The traditional teacher-centered approach to education, which remains prevalent, stifles student engagement and limits the development of critical thinking skills (Amua-Sekyi & Nti, 2015; Peacefmonline, 2022). This has led to a majority of students failing to demonstrate proficiency in key academic areas (Nunoo et al., 2023). Students with special needs are particularly marginalized due to negative perceptions and a lack of adequate resources, which hinders their full participation in the educational system (Mantey, 2017). Children with disabilities are often excluded from education due to being overlooked in data, as well as the absence of accessible schools and supportive infrastructure, resulting in irregular attendance and eventual dropout (UNICEF, n.d.). According to the Ghana News Agency (2022), over 275,000 children aged five to 17 face difficulties in areas such as sight, hearing, physical abilities, intellectual development, self-care, or speech. Disparities based on gender, socioeconomic status, and geography further limit access to quality education for many students

(Atuahene & Owusu-Ansah, 2013). UNICEF (n.d.) notes that adolescent girls in particular face challenges accessing education due to factors such as poverty, gender inequality, and the long distances to schools. Additionally, one-third of children under 18, approximately 3.86 million are considered multidimensionally poor, further exacerbating these challenges (Ghana News Agency, 2022). While strides have been made in improving access to education in Ghana, addressing these issues is crucial to enhancing educational outcomes and ensuring inclusive, quality education for all.

AI as a Policy Response in TL

The findings indicate a possible interconnection among the three explored primary applications of AIEd: student-facing, teacher-facing, and system-facing applications categories, as a single application may have the potential to meet requirements across many domains. For instance, tutorial software can be used to both help teachers and students (Miao et al., 2021).

Student-Facing AI Applications

Student-facing applications also present transformative opportunities for students, particularly through personalized learning experiences and learning materials, which are the biggest promises of AIEd. Personalized learning tailors' education to students' unique needs and strengths, with AI tools helping to customize materials and guide the learning process (Vincent-Lancrin & Van der Vlies, 2020). Student-facing applications like CENTURY, SuaCode.ai, BYJU's Learning App, Maths-Whizz, StorySign, Google Voice Assistant, robots, humanoids, and tutoring software provide tailored educational content, accommodating individual learning styles and needs (Baker & Smith, 2019; Chen et al., 2020; UNESCO, 2019; Vincent-Lancrin & Van der Vlies, 2020). A significant breakthrough in this domain is the development of platforms like CENTURY, which, as detailed by Baker and Smith (2019), leverage AI to chart personalized educational journeys for students. These systems dynamically assess and respond to students' performance in formative assessments and diagnostic tests, offering custom support and guidance. This approach not only identifies areas of proficiency but also pinpoints specific knowledge deficiencies, thereby enabling targeted interventions to bolster the learning process. SuaCode.ai, an AI EdTech startup from Ghana, recently introduced Kwame AI, an AI-powered web app named after Ghana's first president, Dr. Kwame Nkrumah (Citinewsroom, 2022). This platform is designed to assist students with subjects from the WASSCE, offering instant answers, diagrams, and explanations for the top five related past questions, including the year they appeared. Users can input queries like the definition of photosynthesis and receive the best three answers from a curated knowledge base. SuaCode.ai, aiming to democratize science and technology education across Africa, provides early beta access to students, teachers, and parents, and offers a mobile app, SuaCode, to learn coding. BYJU's Learning App, a major success in Indian EdTech, was launched in 2015 as a math and science tutoring app for students in grades four to 12, offering personalized instruction and assessments (Vincent-Lancrin & Van der Vlies, 2020). The app provides video lessons, assesses whether the student has understood concepts, and adapts to the student's understanding by adjusting the learning path. BYJU's became the largest EdTech unicorn, reaching a USD four billion valuation in 2018 with 1.3 million paying users.

Chatbots, in particular, are notable for their ability to engage in dialogue, providing responses and assistance through both spoken and written communication. These tools have shown promise in both responding to and initiating interactions with learners, thereby enhancing the problem-solving process. sQuid in Kenya offers Maths-Whizz, a virtual tutor that is tailored to each student's ability

and gives teachers and students access to learning materials and content, including novels with an African theme, the first children's encyclopedia, and curriculum-aligned revision (UNESCO, 2019). Students-facing applications have the potential to reduce educational disparities by giving marginalized groups, such as people with disabilities, refugees, students not attending school, and those living in remote communities, access to appropriate learning opportunities (Onaolapo & Onifade, 2020). Inclusive education is a key objective of SDG Goal 4, aiming to provide equal access to education for all, including individuals with disabilities (Vincent-Lancrin & Van der Vlies, 2020). AI has proven effective in supporting students with disabilities, such as visual, hearing, or social impairments, by enhancing their learning experience. Specialized systems cater to students with various disabilities, utilizing technologies like AR/VR and robotics to support learning for those with health or mental impairments (Vincent-Lancrin & Van der Vlies, 2020). For example, Huawei's StorySign app can translate text into sign languages, enabling deaf students to read (Miao et al., 2021). AI-powered wearables assist visually impaired students in reading and recognizing faces, enhancing their ability to learn and socialize. Tools like text-to-speech and speech-to-text address certain challenges, while others, such as virtual interactions for autistic students, show promising research outcomes (Vincent-Lancrin & Van der Vlies, 2020). AI-driven automatic speech recognition and transcription, for instance, can be used to provide deaf and hard-of-hearing students with access to live lectures (Miao et al., 2021). Additionally, robots, humanoids, and tutoring software can be employed to enhance learning outcomes for students with autism spectrum disorder (Onaolapo & Onifade, 2020). Speech-enabled robots can also be used to improve social and communication skills for students on the autism spectrum (Miao et al., 2021). Since 2016, Beijing Union University has offered an intelligent speech recognition system that converts spoken language into subtitles, allowing disabled students to follow lessons through multiple channels, including sign language and text. AI-based diagnostic tools for conditions like dyslexia and attention deficit hyperactivity disorder are also increasingly used globally (Vincent-Lancrin & Van der Vlies, 2020).

Teacher-Facing AI Applications

AIEd has emerged as a powerful ally in addressing the multifaceted challenges of teaching. Teacher-facing AI applications aim to reduce teacher workloads and automate administrative tasks such as grading and attendance tracking (Miao et al., 2021). These tools have shown promise in enhancing professional development, fostering collaboration, and improving instructional quality. For instance, platforms like M-Shule (Kenya), Daptio (South Africa), Geekie (Brazil), and Teach to One (U.S.) have revolutionized personalized learning, allowing teachers to cater to individual student needs effectively (UNESCO, 2019). The Brazilian EdTech company Geekie's adaptive learning platform, used by more than 5,000 schools, for instance, offers personalized learning experiences, identifies learning issues that students experience, and provides more individualized content that human instructors use to determine the right solutions (UNESCO, 2019). Adaptive Learning Platforms have been developed and used to allow one teacher to instruct hundreds of thousands of students simultaneously while also providing personalized feedback, marking close or open tests against a humanlike precision of 92%, and offering customized learning in over a thousand schools (Hashakimana & De Dieu Habyarimana, 2020)

In the US, New Classrooms developed the *Teach to One* math program to personalize learning through data (Vincent-Lancrin & Van der Vlies, 2020). The program targets lower-secondary math, adapting instruction daily based on students' abilities. It uses algorithms to assign students to various learning modes, such as teacher-led lessons, group work, and adaptive software. Continuous

assessments identify skill gaps, and students can access dashboards to track their progress and work on personalized tasks. The system supports self-paced learning, with data feeding into an information system to adjust daily learning paths and inform two-week instructional cycles. Moreover, AI's ability to mimic experienced educators suggests the potential to supplement the teaching workforce, especially in areas with acute teacher shortages (Kukulska-Hulme et al., 2021).

System-Facing AI Applications

System-facing AI tools offer solutions to improve school management and operational efficiency. By automating processes and providing real-time data, these applications can significantly enhance record-keeping, scheduling, and performance monitoring (Miao et al., 2021). For example, the Open University's OU Analyse tool demonstrates how AI can predict student outcomes and identifies students at risk of failing by analyzing data from the university's education management information systems. This data helps support staff and course instructors to identify the best way to help struggling students (Miao et al., 2021). Similarly, Swift eLearning Services in India has created a system called *Swift* which uses data from an e-learning module to assist education management information systems systems and provide insight into learner progress. This system helps to create personalized learning pathways tailored to the learner's preferences (Miao et al., 2021). The UniTime project in the US, a large AI-powered educational scheduling system, makes schedules for university courses and exams, handles time and room changes, and provides students with their own schedules (Miao et al., 2021). TAL Education Group, one of China's largest out-of-school tutoring companies, offers in-school services (Vincent-Lancrin & Van der Vlies, 2020). Its AI lab has developed tools to help students prepare for university entrance exams. The *Adaptive Test and Learning Plan* analyzes a large question database to provide personalized questions, assess students' knowledge levels, and recommend appropriate offline classes. The system also creates customized study plans and shares relevant materials with parents. Moreover, as educators and policymakers focus on identifying key indicators to predict and prevent student dropout, system-facing AI have the potential to enhance early warning systems by leveraging the growing availability of longitudinal data in education (Vincent-Lancrin & Van der Vlies, 2020).

Discussions

Integrating AI in Ghanaian Education - Opportunities and Challenges

Interpretation of Findings in the Broader Context

The findings presented offer a detailed look at the potential role of AI in revolutionizing Ghana's educational landscape. While AI promises significant enhancements in teaching effectiveness, student engagement, and administrative efficiency, its integration must be contextualized within the broader framework of educational research and policy. The nuanced nature of Ghana's educational challenges, coupled with cultural, economic, and infrastructural considerations, calls for a critical examination of AI's potential as a transformative tool in education.

Opportunities Presented by AIEd

The integration of AI into Ghanaian education presents numerous opportunities. AI's capability to personalize learning can address the diverse needs of students, providing tailored educational experiences that are otherwise difficult to achieve in overcrowded and resource-constrained

classrooms (Miao et al., 2021; Vincent-Lancrin & Van der Vlies, 2020). Teacher-facing AI applications can alleviate the workload on educators, allowing them to focus more on pedagogy and less on administrative tasks (Baker & Smith, 2019; Miao et al., 2021). System-facing applications promise to streamline school operations, improving the efficiency and effectiveness of educational institutions (Baker & Smith, 2019; Miao et al., 2021). Moreover, AI's ability to provide access to quality education and personalized learning experiences regardless of geographic or socioeconomic barriers aligns with the inclusive ethos of SDG 4, aiming to ensure inclusive and equitable quality education for all (Nunoo et al., 2023).

Cultural Considerations in AI Integration

Cultural factors play a crucial role in the successful integration of AI in Ghanaian education. The traditional teacher-centered approach prevalent in Ghana may conflict with the more student-centered, autonomous learning models promoted by AI (Amua-Sekyi & Nti, 2015). Therefore, a cultural shift might be necessary to fully realize AI's potential. This shift requires not only policy support but also community engagement to ensure that AI-enhanced education is culturally sensitive and contextually relevant. Additionally, crucial needs include developing a collaborative AI curriculum for teachers (Chiu et al., 2021) and encouraging a more open-minded approach to student-centered teaching in curriculum design (Reigeluth et al., 2017).

Economic and Infrastructural Challenges

Economic and infrastructural challenges pose significant barriers to the widespread adoption of AI in Ghana. The initial cost of implementing AI technologies can be prohibitive due to limited educational resources (Agormedah et al., 2020). Moreover, the lack of broadband infrastructure, particularly in underserved areas, and the high cost of services for most Ghanaians, along with complaints of poor service quality, pose significant challenges (Sam, 2020). Addressing these challenges requires not only substantial investment but also strategic partnerships between the government, private sector, and international organizations (Sam, 2020; UNESCO, 2019).

Balancing the Promise and Pitfalls of AIEd

While AI offers promising solutions, it is also fraught with challenges. There's a risk that AI could exacerbate existing inequalities if access to these technologies is uneven (UNESCO, 2019). Biases have been found to be reflected in misinformed educational interventions, false predictions of student performance, and inadequate representation of diverse student needs (Baker & Hawn, 2021; du Boulay, 2022; Gaskins, 2023). Moreover, over-reliance on AI could potentially diminish the role of teachers, undermining their professional autonomy and the relational aspects of teaching that are crucial for student development (Edwards & Cheok, 2018). The alleged use of answers generated by AI among students in Ghana during WASSCE reveals a deep concern about academic dishonesty (Citinewsroom, 2023). The ethical implications of data privacy, consent, and security also need careful consideration (Miao et al., 2021; Vincent-Lancrin & Van der Vlies, 2020). Therefore, a balanced approach is needed, one that leverages AI's strengths while mitigating its risks.

Theoretical and Empirical Evidence

The discussion on AIEd is supported by both theoretical and empirical evidence. Constructivist learning theories, which emphasize the active role of learners in constructing their own understanding,

provide a theoretical framework for understanding how AI can facilitate personalized, autonomous learning (Fosnot, 2013). Empirically, studies from other contexts have demonstrated the effectiveness of AI in improving learning outcomes, teacher performance, and administrative efficiency (Miao et al., 2021; Vincent-Lancrin & Van der Vlies, 2020). These insights can inform the strategic implementation of AI in Ghana, ensuring that it is evidence-based and theoretically sound.

Conclusions

This study has highlighted the transformative potential of AI in addressing the TL challenges within the Ghanaian education system. By leveraging AI and focusing on the specific needs and conditions of Ghanaian education, Ghana can enhance educational outcomes through personalized learning experiences, increased teacher efficiency, and improved administrative processes. However, the successful integration of AI requires a strategic, contextually sensitive approach that considers Ghana's unique cultural, economic, and infrastructural realities. The findings emphasize the importance of a collaborative effort involving policymakers, educators, and stakeholders to ensure equitable, ethical, and effective deployment of AIEd. Despite the promising opportunities, there are significant challenges that must be addressed. These include infrastructural deficits, economic constraints, and the need for robust ethical frameworks to manage data privacy and bias. By recognizing and addressing these challenges, Ghana can make substantial strides towards achieving its educational and developmental goals, ensuring that AI serves as a powerful tool for enhancing the quality and accessibility of education for all students.

Recommendations

Recommendations for Policymakers, Educators, and Stakeholders

The integration of AI into education presents immense opportunities and challenges in Ghana. Table 1 outlines key recommendations for policymakers, educators, and stakeholders in Ghana, aiming to maximize the benefits of AIEd while mitigating potential risks.

Table 1. Recommendations for Integrating AI in Ghanaian Education

	Recommendation	Description
1	**Development of an Innovative AI Policy Strategy**	Tailor an AI policy strategy specific to the Ghanaian context, involving collaboration between governments, academic institutions, and private entities to harness AI's potential while addressing local needs and challenges. The government can assign oversight of AIEd to an existing ministry or department, create a new governmental or independent body for AIEd, establish expert advisory groups for AIEd, or form oversight and advisory bodies for AIEd and data ethics within various Ghanaian educational institutions, including both developed and remote areas (Galindo et al., 2021).
2	**Promotion of AIEd Awareness at All Levels**	Promote awareness about the employment opportunities presented by AI to counter fears of AI replacing human jobs, emphasizing the demand for AI practitioners and researchers.
3	**Teacher Training Programs for Current and Future Teachers**	Implement training programs for teachers on AIEd usage, equipping them with skills to use AI tools effectively, enhance teaching methods, and prepare for the evolving educational environment.
4	**Addressing Cultural, Economic, and Infrastructural Challenges**	Policies and initiatives must take into account the cultural acceptance of AI, the economic feasibility of implementing AI solutions, and the infrastructural readiness of schools to adopt new technologies. This includes investing in technological infrastructure, ensuring reliable and high-speed internet access, and making AI tools accessible to all.
5	**Ensuring Equitable Access**	Ensure AI tools are accessible to all students, irrespective of socioeconomic status, geographic location, or disability, to minimize inequalities and distribute AIEd benefits widely.
6	**Regular Evaluation and Adaptation**	Continuously monitor and evaluate AI initiatives for effectiveness, identify improvement areas, and adapt strategies as needed, ensuring AI tools remain relevant in the evolving educational landscape.
7	**Educating students on the proper and acceptable uses of AI in educational settings**	Provide guidelines on responsible and ethical AI usage, teaching students to leverage AI effectively while maintaining academic integrity.

Limitations and Future Research Directions

While this study offers a detailed analysis of the potential of AIEd in addressing Ghana's TL challenges, there are inherent limitations that need to be considered. These limitations should inform future research and guide the strategic implementation of AIEd. One key limitation of this study is the reliance on secondary data sources, which may not fully capture the nuanced and contextualized experiences of educators and students in Ghana. Although the literature synthesis method provided valuable insights into the current and potential role of AIEd, there is a lack of primary empirical data from key stakeholders directly involved in the TL process, such as teachers, students, and policymakers in the Ghanaian educational system. Additionally, the study focused heavily on the potential applications and benefits of AI without an in-depth exploration of the infrastructural constraints that might impede its widespread implementation. Issues such as inconsistent internet access, inadequate technological infrastructure, and the high cost of AI tools and systems are critical factors that may limit AI adoption, especially in rural or underfunded schools in Ghana. These factors were acknowledged but not extensively addressed in terms of specific interventions or scalable solutions. Another limitation lies in the ethical and regulatory aspects of AI integration in education. Although this study touched on ethical concerns, such as data privacy, bias, and the risk of AI deepening existing educational inequalities, further exploration is needed to understand the full implications of these issues.

Future research should prioritize empirical studies that assess the real-world impact of AI in various educational settings within Ghana. Pilot programs, longitudinal studies, and case studies focusing on AI integration in both urban and rural schools will be essential to gain a clearer understanding of its practical benefits and challenges. Specifically, research should:

1. *Investigate Stakeholder Perceptions and Experiences:* Collect primary data from educators, students, parents, and policymakers in developed and remote areas to understand their attitudes toward AI, their readiness for its adoption, and any concerns they may have about its implementation.
2. *Assess Infrastructural Barriers:* Detailed studies are needed to evaluate the technological readiness of schools in different regions of Ghana, focusing on internet accessibility, hardware availability, and the financial resources required to implement AI solutions.
3. *Explore AI for Inclusive Education and Culturally Relevant AI Tools:* Future studies should investigate how AI can be effectively used to support students with special educational needs and disabilities. The potential of AI in creating personalized learning environments for marginalized students, such as those with disabilities or those in remote areas, requires further exploration. Additionally, an exploration into the development of culturally relevant AI tools and applications will be essential.
4. *Ethical and Legal Frameworks:* Research should also explore the development of ethical guidelines and legal frameworks that address issues such as data privacy, algorithmic bias, and the potential marginalization of certain student groups. It is critical to ensure that AI applications in education adhere to principles of fairness, transparency, and accountability.
5. *Long-Term Impact on Educators:* Studies should also examine the long-term impact of AI on the roles of teachers. While AI can supplement teaching by automating administrative tasks, it is important to explore how it will influence teachers' professional development, instructional methods, and their interaction with students over time.
6. *Scalability of AI Solutions:* Future research should focus on developing scalable AI solutions that can be adopted by schools with varying levels of resources. This will include assessing

the cost-effectiveness of AI tools and developing models for public-private partnerships to finance AI integration in education.

By addressing these areas, future research can contribute to the development of a robust, contextually relevant AI framework for education in Ghana, ensuring that its integration is both sustainable and equitable.

References

Adarkwah, M. A., Amponsah, S., van Wyk, M. M., Huang, R., Tlili, A., Shehata, B., Hosny Saleh Metwally, A., & Wang, H. (2023). Awareness and acceptance of ChatGPT as a generative conversational AI for transforming education by Ghanaian academics: A two-phase study. *Journal of Applied Learning and Teaching, 6*(2), 78-93. https://doi.org/10.37074/jalt.2023.6.2.26

Agormedah, E. K., Henaku, E. A., Ayite, D. M. K., & Ansah, E. A. (2020). Online learning in higher education during COVID-19 pandemic: A case of Ghana. *Journal of Educational Technology and Online Learning, 3*(3), 183-210. https://doi.org/10.31681/jetol.726441

Amegadzie, J. K., Kanubala, D. D., Cobbina, K. A., & Acquaye, C. (2021, May 31-June 2). *State and future prospects of artificial intelligence (AI) in Ghana* [Conference presentation]. Academic City University College, Accra, Ghana. https://www.isteams.net/_files/ugd/185b0a_0643cb81745649b387fae67543d2bbec.pdf

Ampofo, J. W., Emery, C. V., & Ofori, I. N. (2023). Assessing the level of understanding (knowledge) and awareness of diagnostic imaging students in Ghana on artificial intelligence and its applications in medical imaging. *Radiology Research and Practice,* Article 4704342, 1-9. https://doi.org/10.1155/2023/4704342

Amua-Sekyi, E. T., & Nti, S. K. (2015). Factors affecting students' performance in English at colleges of education in Ghana. *Impact Journals, 3*(10), 29-44.

Annan, J. K. (2020). Preparing globally competent teachers: A paradigm shift for teacher education in Ghana. *Education Research International,* Article 8841653, 1-9. https://doi.org/10.1155/2020/8841653

Appiahene, P., Opoku, M., Akweittey, E., Adoba, E., & Kwarteng, R. (2014). Assessing the challenges of learning and teaching of mathematics in second cycle institutions in Ghana. *International Journal of Innovation and Applied Studies, 6*(3), 362–368.

Atuahene, F., & Owusu-Ansah, A. (2013). A descriptive assessment of higher education access, participation, equity, and disparity in Ghana. *Sage Open, 3*(3), 1-16. https://doi.org/10.1177/2158244013497725.

Baker, R. S., & Hawn, A. (2021). Algorithmic bias in education. *International Journal of Artificial Intelligence in Education*, *32*, 1052–1092. https://doi.org/10.1007/s40593-021-00285-9

Baker, T., & Smith, L. (2019). *Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges.* Nesta. https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdf

Binns, R. (2018). Algorithmic accountability and public reason. *Philosophy & Technology*, *31*(4), 543-556. https://doi.org/10.1007/s13347-017-0263-5

Bodner, G. M. (1986). Constructivism: A theory of knowledge. *Journal of Chemical Education, 63*(10), 873-878. http://dx.doi.org/10.1021/ed063p873

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Butakor, P. K. (2023). Exploring pre-service teachers' beliefs about the role of artificial intelligence in higher education in Ghana. *International Journal of Innovative Technologies in Social Science*, *3*(39), 1-14. http://dx.doi.org/10.31435/rsglobal_ijitss/30092023/8057

Carter, E., Hinton, R., Rose, P., & Sabates, R. (2023). Exploring the role of evidence in the government's adoption of Ghana's Complementary Basic Education program. *Development in Practice, 33*(8), 960-974. https://doi.org/10.1080/09614524.2023.2208772

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access, 8*, 75264-75278. https://doi.org/10.1109/ACCESS.2020.2988510

Chiu, T. K., Meng, H., Chai, C. S., King, I., Wong, S., & Yam, Y. (2021). Creation and evaluation of a pretertiary artificial intelligence (AI) curriculum. *IEEE Transactions on Education*, *65*(1), 30-39.

Citinewsroom. (2022). *Ghanaian designs AI web app to provide instant answers on science.* https://citinewsroom.com/2022/06/ghanaian-designs-ai-web-app-to-provide-instant-answers-on-science/

Citinewsroom. (2023, December 18). *2023 WASSCE: Results of some students withheld over AI answers*. https://citinewsroom.com/2023/12/2023-wassce-results-of-some-students-withheld-over-ai-answers/

Cope, B., Kalantzis, M., & Searsmith, D. (2021). Artificial intelligence for education: Knowledge and its assessment in AI-enabled learning ecologies. *Educational Philosophy and Theory, 53*(12), 1229-1245. https://doi.org/10.1080/00131857.2020.1728732

Costanza-Chock, S. (2020). *Design justice: Community-led practices to build the worlds we need*. The MIT.

Diplo. (2023). *Artificial intelligence in Africa: National strategies and initiatives.* Diplo Resource. https://www.diplomacy.edu/resource/report-stronger-digital-voices-from-africa/ai-africa-national-policies/#:~:text=Ghana%20and%20Uganda%20have%20been%20part%20of%20the

Du Boulay, B. (2022). Artificial intelligence in education and ethics. In O. Zawacki-Richter, & I. Jung (Eds.), *Handbook of open, distance and digital education* (pp. 1-16). Springer. https://doi.org/10.1007/978-981-19-0351-9_6-1

Du Boulay, B. (2024). Pedagogy, cognition, human rights, and social justice. *International Journal of Artificial Intelligence in Education*, *34*, 116–121. https://doi.org/10.1007/s40593-023-00355-0

DW Documentary. (2019, February 25). *Meet Germany's first robot lecturer DW documentary* [Video]. YouTube. https://www.youtube.com/watch?v=Amfrm2V_KO0

Edwards, B. I., & Cheok, A. D. (2018). Why not robot teachers: Artificial intelligence for addressing teacher shortage. *Applied Artificial Intelligence, 32*(4), 345-360. https://doi.org/10.1080/08839514.2018.1464286

Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., & Baah, P. K. (2022). The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *International Journal of Educational Technology in Higher Education, 19*(57), 1-19. https://doi.org/10.1186/s41239-022-00362-6

Fengchun, M., Wayne, H., Huang, R., & Zhang, H. (2021). *AI and education: A guidance for policymakers*. UNESCO.

Fosnot, C. T. (2013). *Constructivism: Theory, perspectives, and practice*. Teachers College.

Galindo, L., Perset, K., & Sheeka, F. (2021). *An overview of national AI strategies and policies*. OECD. https://www.oecd-ilibrary.org/docserver/c05140d9-en.pdf?expires=1733849520&id=id&accname=guest&checksum=B555C352C1FCBC035265628B739CED51

Gaskins, N. (2023). Interrogating algorithmic bias: From speculative fiction to liberatory design. *TechTrends*, *67*(3), 417-425. https://doi.org/10.1007/s11528-022-00783-0

Ghana News Agency. (2022, November 21). International children's day: 1.2 million Ghanaian children not in school. *Ghana News Agency*. https://gna.org.gh/2022/11/international-childrens-day-1-2-million-ghanaian-children-not-in-school/

Ghann, P. (2020). Deploying AI as teachers in rural areas of Ghana. *American Journal of Computer Science and Information Technology, 8*(5), 1-7.

Gwagwa, A., Kraemer-Mbula, E., Rizk, N., Rutenberg, I., & De Beer, J. (2020). Artificial intelligence (AI) deployments in Africa: Benefits, challenges, and policy dimensions. *The African Journal of Information and Communication, 26*, 1-28. https://doi.org/10.23962/10539/30361

Hashakimana, T., & De Dieu Habyarimana, J. (2020). The prospects, challenges, and ethical aspects of artificial intelligence in education. *Journal of Education, 3*(7), 14-27. https://www.stratfordjournal.org/journals/index.php/journal-of-education/article/view/655/764

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education promises and implications for teaching and learning*. Center for Curriculum Redesign.

Holmes, W., Fadel, C., & Bialik, M. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.

Humble, N., & Mozelius, P. (2019, October 31- November 1). *Artificial intelligence in education—A promise, a threat, or a hype* [Conference presentation]. ACPI, Oxford, United Kingdom.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology*. Sage.

Kukulska-Hulme, A., Bossu, C., Coughlan, T., Ferguson, R., FitzGerald, E., Gaved, M., Herodotou, C., Rienties, B., Sargent, J., Scanlon, E., Tang, J., Wang, Q., Whitelock, D., & Zhang, S. (2021). *Innovating pedagogy 2021.* The Open University.

Longe, O. B, Sharma, N., Amegadzie, J., Acquaye, C., & Kanubala, D. (2021, October 24-26). *The future is intelligent: Empowering future ready workforce through artificial intelligence (AI) education at the Academic City University College Accra Ghana* [Conference presentation]. American International University, Serrekunda, Gambia.

Mantey, E. E. (2017). Discrimination against children with disabilities in mainstream schools in southern Ghana: Challenges and perspectives from stakeholders. *International Journal of Educational Development, 54*, 18-25. https://doi.org/10.1016/j.ijedudev.2017.02.001

McArthur, D., Lewis, M., & Bishary, M. (2005). The roles of artificial intelligence in education: Current progress and future prospects. *Journal of Educational Technology, 1*(4), 42-80.

Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). *AI and education: A guidance for policymakers*. UNESCO.

Mills-Tettey, G. A., Dias, M. B., Browning, B., & Amanquah, N. (2007). *Teaching technical creativity through robotics: A case study in Ghana*. Robotics Institute Carnegie Mellon University. https://www.ri.cmu.edu/publications/teaching-technical-creativity-through-robotics-a-case-study-in-ghana/

Mohammed, A. S. (2023). Examining the implementation of artificial intelligence in early childhood education settings in Ghana: Educators' attitudes and perceptions towards its long-term viability. *American Journal of Education and Technology, 2*(4), 36-49. https://doi.org/10.54536/ajet.v2i4.2201

Mohammed, I., & Amponsah, O. (2018). Predominant factors contributing to low reading abilities of pupils at Elsie Lund Basic School in the Tamale Metropolis, Ghana. *African Educational Research Journal, 6*(4), 273-278. https://doi.org/10.30918/AERJ.64.18.071

Newton, D. P., & Newton, L. D. (2019). Humanoid robots as teachers and a proposed code of practice. *Frontiers in Education*, *4*(125), 1-10. https://doi.org/10.3389/feduc.2019.00125

Nsoh, A. M., Joseph, T., & Adablanu, S. (2023). Artificial intelligence in education: Trends, opportunities, and pitfalls for institutes of higher education in Ghana. *International Journal of Computer Science and Mobile Computing, 12*(2), 38–69. https://doi.org/10.47760/ijcsmc.2023.v12i02.004

Nunoo, J., Taale, F., Sebu, J., & Adama, A. S. Y. (2023). Influence of teacher absenteeism and school distance on cognitive skills in Ghana. *International Journal of Educational Development, 97*, 1-9. https://doi.org/10.1016/j.ijedudev.2022.102715

Nyaaba Akanzire, B., Nyaaba, M., & Nabang, M. (2023). *Perceptions and preparedness: Exploring teacher educators' views on integrating generative AI in colleges of education* [Working paper]. SSRN. https://dx.doi.org/10.2139/ssrn.4628153

Nyaaba, M., & Zhai, X. (2024). Generative AI professional development needs for teacher educators. *Journal of AI, 8*(1), 1-13. https://doi.org/10.61969/jai.1385915

Ofosu-Ampong, K., Acheampong, B., Kevor, M. O., & Amankwah-Sarfo, F. (2023). Acceptance of artificial intelligence (ChatGPT) in education: Trust, innovativeness and psychological need of students. *Information and Knowledge Management, 13*(4), 37-47. https://doi.org/10.7176/IKM/13-4-03

Onaolapo, S., & Onifade, T. (2020, September 21-22). *Teaching and learning in the cloud: Prospects and challenges of artificial intelligence for education in Africa* [Conference presentation]. European Center of Sustainable Development, Rome, Italy.

Opoku, M. P., Badu, E., Amponteng, M., & Agyei-Okyere, E. (2015). Inclusive education at the crossroads in Ashanti and BrongAhafo regions in Ghana: Target not achievable by 2015. *Disability, CBR and Inclusive Development, 26*(1), 63-78. https://doi.org/10.5463/DCID.v26i1.401

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence, 2*, Article 100020, 1-6. https://doi.org/10.1016/j.caeai.2021.100020

Paek, S., & Kim, N. (2021). Analysis of worldwide research trends on the impact of artificial intelligence in education. *Sustainability*, *13*(14), 1-20. https://doi.org/10.3390/su13147941

Peacefmonline. (2022). *No Ghanaian student has ever asked me a question in class - Education Minister laments "timid" system*. https://neatfm.peacefmonline.com/pages/local/202209/474676.php

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., & Duffy, S. (2006). *Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC methods programme.* Lancaster University.

Ragin, C. C. (1987). *The comparative method: Moving beyond qualitative and quantitative strategies*. University of California.

Reigeluth, C. M., Beatty, B. J., & Myers, R. D. (2017). The learner-centered paradigm of education. In C. M. Reigeluth, B. J. Beatty, & R. D. Myers (Eds.), *Instructional-design theories and models* (pp. 5-32). Routledge.

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education, 26*(2), 582–599. https://doi.org/10.1007/s40593-016-0110-3

Sabzalieva, E., & Valentini, A. (2023). *ChatGPT and artificial intelligence in higher education: Quick start guide.* UNESCO.

Sam, K. (2020, August 21). *Barriers to artificial intelligence adoption in Ghana - Institute of ICT professionals, Ghana*. IIPGH. https://iipgh.org/barriers-to-artificial-intelligence-adoption-in-ghana/

Schiff, D. (2022). Education for AI, not AI for education: The role of education and ethics in national AI policy strategies. *International Journal of Artificial Intelligence in Education*, *32*(3), 527-563. https://doi.org/10.1007/s40593-021-00270-2

Segbenya, M., Bervell, B., Frimpong-Manso, E., Otoo, I. C., Andzie, T. A., & Achina, S. (2023). AI in higher education: Modelling the antecedents of AI usage and effects on 21st-century employability skills among

postgraduate students in Ghana. *Computers and Education: Artificial Intelligence, 5,* Article 100188, 1-13. https://doi.org/10.1016/j.caeai.2023.100188

Suuk, M., & Mwakideu, C. (2023, June 26). *Ghana debates regulating artificial intelligence*. Dw.com. https://www.dw.com/en/ghana-debates-regulating-artificial-intelligence/a-66025595

NESCO. (2019). *Beijing consensus on artificial intelligence and education* [Brochure]. https://unesdoc.unesco.org/ark:/48223/pf0000368303

UNICEF. (n.d.). *Education.* Retrieved November 20, 2024, from https://www.unicef.org/ghana/education

Vincent-Lancrin, S., & van der Vlies, R. (2020, April 6). *Trustworthy artificial intelligence (AI) in education: Promises and challenges.* OECD. https://www.oecd-ilibrary.org/education/trustworthy-artificial-intelligence-ai-in-education_a6c90fa9-en

Whittaker, M., Crawford, K., Dobbe, R., Fried, G., Kaziunas, E., Mathur, V., & Schwartz, O. (2018). *AI now report 2018*. AI Now Institute. https://ainowinstitute.org/wp-content/uploads/2023/04/AI_Now_2018_Report.pdf

World Bank. (2021, May). *Harnessing artificial intelligence for development on the post-COVID-19 era: A review of national AI strategies and policies.* Open Knowledge Repository. https://openknowledge.worldbank.org/entities/publication/54526b85-6e91-58f4-ac27-fe9cbbc6bdbb

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