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A Thorough Review of AI Developments in Education: Historical Progress, Current Applications, and Future Directions

Selorm Adablanu[1*], Benjamin Ghansah[1], Ben-Bright Benuwa[1], Stephen Opoku Oppong[1]

[1] University of Education, Winneba, Ghana

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Corresponding Author:
Selorm Adablanu
sadablanu@uew.edu.gh

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Abstract: Artificial Intelligence (AI) and associated technologies have profoundly transformed the education sector, becoming pivotal in driving innovation and modernization. AI's influence spans across various facets of education, from technological advancements to theoretical progress, offering significant pedagogical benefits through tools like intelligent tutoring systems for content delivery, real-time feedback, and student progress tracking. As a machine-driven technology capable of generating predictions, recommendations, and informed decisions, AI's relevance in education has surged due to its capacity to enhance learning in diverse settings. This paper provides an in-depth review of how AI and related technologies have revolutionized education. It posits that integrating Intelligent Tutoring Systems (ITS) can refine predictive models used by AI algorithms in eLearning platforms. Based on previous studies, the emphasis on AI in education, coupled with its thoughtful implementation to meet the needs of both instructors and learners, remains crucial for optimizing lesson delivery and outcomes.

Keywords: Artificial Intelligence; Machine Learning; intelligent tutoring system (ITS); ChatGPT; Education Sector

Introduction

The swift advancement of innovations like artificial intelligence (AI) and machine learning (ML) has profoundly influenced various activities, including education. Although AI is now embedded in our daily lives, its integration into educational contexts is still rare, as classroom practices evolve much more slowly than technological advancements. In this era of the Fourth Industrial Revolution, nearly all human activities are intertwined with Information Technology (IT), which serves as a facilitator for numerous functions and services. IT has transitioned from being a mere tool to a vital component necessary for daily life. Its advancements have created a strong dependence on IT availability for enhancing daily human activities (Rahmatullah et al., 2022).

However, modern AI frameworks, with their capacity to enhance personalized learning, are poised to significantly transform the educational sector. Research indicates that computer games, adaptive learning, logical reasoning, and online support will become commonplace in classrooms within the next 15 years. To harness AI's full potential for education, it is crucial to continue exploring and integrating cutting-edge technologies in classrooms. Many students already use AI for online entertainment, and educators are beginning to adopt it for teaching purposes.

The rapid advancements in big data and AI technologies have had extensive impacts on various aspects of society, including the economy, politics, research, and education (Luan et al., 2020). AI, a machine-based technology with algorithmic capabilities for making predictions, diagnoses, recommendations, and decisions, has become increasingly significant in education due to its potential to enhance learning across different contexts. AI applications in education, such as intelligent tutors for content delivery, feedback, and progress monitoring, have shown technological advancements, theoretical developments, and positive pedagogical outcomes (X. Chen et al., 2022). Therefore, the application of AI in education is a critical issue, and this study aims to thoroughly analyze AI's impact on the educational field.

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The history of AI technology development and evolution is extensive, focusing on intelligent agents aware of their surroundings and capable of actions that increase their success chances (Shabbir & Anwer, 2018). The term "artificial intelligence" often brings to mind supercomputers with immense processing power and adaptive behaviors, including the use of sensors and other components that enable human-like cognition and functionality, enhancing their interaction with humans (L. Chen et al., 2020). AI refers to the capability of a computer program to learn and think, encompassing any software that performs tasks typically requiring human intelligence (Ouyang & Jiao, 2021).

Background and Context

Over the past quarter-century, AI has seen remarkable progress in the educational sector worldwide (Roll & Wylie, 2016). As advancements in computing and information processing continue, AI is increasingly integrated into education, bringing vast potential to revolutionize higher education (A. Nsoh et al., 2023). AI presents numerous opportunities and challenges for educational methodologies (Ouyang & Jiao, 2021). Its objectives include enhancing educational processes through practical applications, modular prototypes, statistical analysis, data visualization, and learning enhancement (Alam, 2021). A primary goal is to provide personalized learning support tailored to individual student needs and characteristics (Hwang, 2014; Hwang et al., 2020).

Moreover, AI aims to support instructional delivery by understanding and aiding computer-supported cooperative learning through discourse analysis and performance prediction using academic knowledge mining. In this context, teachers play a crucial role, and their acceptance of AI is essential. However, less experienced teachers often struggle with real-time responses to analytics from AI applications, leading to hesitation and lower adoption rates. Increasing teacher acceptance of AI systems is crucial (X. Chen et al., 2022). Collaboration among academics, educators, policymakers, and professionals is necessary to address the opportunities and challenges posed by the AI and big data revolution, enhancing learners' skills for the 21st-century knowledge economy.

AI in education has created new avenues for developing more effective learning activities and technology-enhanced learning environments. Key components of AI technology in education include teacher feedback, automated grading systems, adaptive learning, and distance learning (Hwang et al., 2020; Yufei et al., 2020). Teacher feedback, a traditional assessment method, has transitioned from paper to online surveys with minimal progress. Prioritizing student evaluations of education is essential as they provide valuable insights. AI-powered technologies like conversational agents, machine learning, and natural language processing can improve feedback quality (Holstein et al., 2019; Peters, 2019).

Automated grading systems, powered by AI, replicate teacher grading by assessing student understanding, analyzing responses, providing feedback, and creating personalized training programs. These systems are utilized in various AI teaching applications and offer immediate learner assessment scores during tests (Yufei et al., 2020). AI also significantly enhances online learning by improving the connectivity between students and teachers in distance learning environments. AI and other intelligent systems play a vital role in advancing distance education (Kose & Koc, 2015).

Evolution of AI in Education: Milestones and Key Developments

The journey of AI in education has been marked by significant milestones and crucial developments, transforming teaching and learning methodologies. From early applications in the 1960s to the integration of advanced technologies like machine learning and virtual reality, AI has progressively reshaped educational practices.

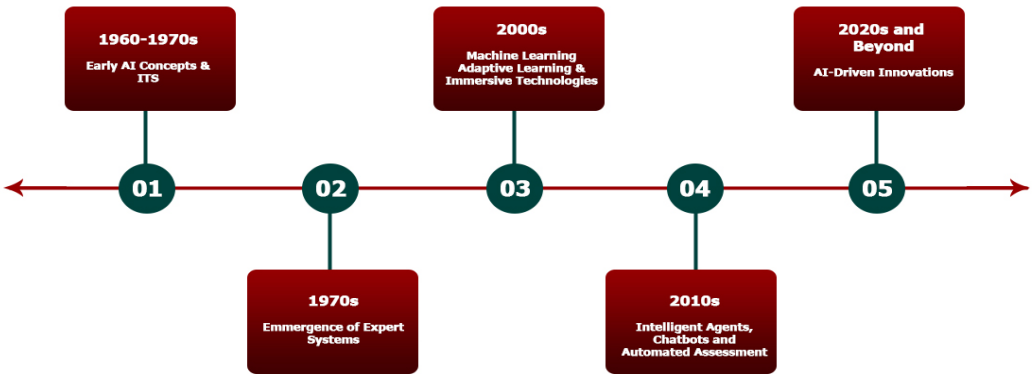

Figure 1. Evolution of AI in Education

Significant milestones and crucial developments have marked the progress of AI in education. Early applications of artificial intelligence (AI) in educational contexts can be traced back to the 1960s and 1970s, when Intelligent Tutoring Systems (ITS) arose as a pioneering concept (Anderson et al., 1985).

Pioneering Concepts and Intelligent Tutoring Systems (1960s - 1970s): The early applications of artificial intelligence (AI) in education can be traced back to the 1960s and 1970s. During this period, Intelligent Tutoring Systems (ITS) emerged as a pioneering concept. ITS aimed to provide personalized and adaptive instruction by utilizing AI techniques to simulate human tutoring. One notable example is the development of the SCHOLAR system, which was designed to interact with students in natural language, setting the stage for the future integration of AI in educational environments (Anderson et al., 1985).

Expert Systems and Domain-Specific Knowledge (1970s): In the 1970s, expert systems began to make their mark in education. These systems were designed to emulate human expertise in specific domains, offering domain-specific knowledge and support. For example, the MYCIN system was initially developed for medical diagnosis but served as a model for educational expert systems that could aid in instructional design and curriculum development (Lebow, 1993).

Adaptive Learning and Machine Learning (1990s): The 1990s saw significant advancements in AI with the introduction of adaptive learning systems. These systems employed machine learning techniques to assess student data in real time and adjust content and resources to meet individual learning needs. An early example of this is the use of AI-driven educational software that could modify instructional material based on student performance (Sung et al., 2016).

E-Learning and Integration of AI (2000s): The 2000s marked the rise of e-learning platforms and the further integration of AI. Tools such as Duolingo utilized AI to adapt to individual learning styles, providing personalized language instruction. Additionally, AI began to play a crucial role in online education by enhancing the learning experience through tailored content and feedback.

Big Data, Learning Analytics, and Virtual Reality (2010s): The 2010s brought the utilization of big data and learning analytics, transforming the way educators track and enhance student progress. AI technologies were also employed to integrate virtual reality (VR) and augmented reality (AR) into education, creating immersive learning environments that significantly boosted student engagement and understanding. These developments allowed for more interactive and effective learning experiences (Sung et al., 2016).

AI-Driven Innovations (2020s and Beyond): In the 2020s, AI has continued to revolutionize education through the use of intelligent agents and chatbots that provide instant responses to student queries and personalized guidance. AI-driven automated assessment tools, such as automated essay scoring systems, have streamlined grading processes and offered consistent, objective evaluations. These advancements illustrate the significant impact of AI on teaching and learning methodologies, offering tailored and immersive educational experiences for students (Shermis & Burstein, 2003).

Overall, the progress of AI in education has led to substantial breakthroughs in teaching and learning. From early ITS and expert systems to contemporary AI-driven tools and virtual reality, AI has significantly enhanced educational practices, paving the way for further innovations and improvements in the future.

Current State of AI Technologies and Tools Used in Education

In the field of education, there is a wide range of AI technologies and tools that have been developed and implemented. These advancements have transformed teaching and learning practices, providing new opportunities for personalized and adaptive instruction. Intelligent tutoring systems (ITS), learning analytics, natural language processing (NLP), machine learning (ML), and virtual reality (VR) are some of the current AI tools utilized in education (Baker & Inventado, 2014).
Artificial Intelligence (AI) technologies have significantly transformed the education sector by providing innovative tools and personalized learning experiences. Here's a detailed overview of the current state of AI technologies and tools used in education:

1. Adaptive Learning Platforms

Adaptive learning platforms use AI algorithms to customize educational content to meet the needs of individual students. These platforms continuously assess a student's performance and adjust the learning path accordingly, providing personalized support and resources. Examples include Smart Sparrow and Knewton, which tailor lessons based on real-time student data, enhancing engagement and learning outcomes (Taylor et al., 2021).

2. Intelligent Tutoring Systems (ITS)

Intelligent Tutoring Systems provide one-on-one tutoring by simulating a human tutor. They can offer immediate feedback and personalized instructions,

making learning more efficient. Tools like Carnegie Learning and the AutoTutor system are designed to help students understand complex subjects by adapting to their learning styles and providing targeted support (Contrino et al., 2024).

3. AI-Powered Assessment Tools

AI-powered assessment tools streamline the grading process by automating evaluations. These tools can analyze student responses, provide feedback, and even detect patterns in student errors to offer insights into their understanding. Examples include Gradescope and Turnitin, which use AI to assess assignments and detect plagiarism, ensuring academic integrity and efficiency in evaluation (Contrino et al., 2024).

4. Natural Language Processing (NLP) Applications

NLP technologies are used to develop chatbots and virtual assistants that support students and educators. These tools can answer questions, provide study recommendations, and assist with administrative tasks. IBM's Watson Tutor and Microsoft's Azure Bot Service are examples of how NLP is being used to enhance educational experiences by providing real-time support and resources (Taylor et al., 2021).

5. Predictive Analytics

Predictive analytics in education involve using AI to analyze data and predict student performance and potential challenges. These insights help educators to intervene early and provide necessary support to at-risk students. Platforms like Civitas Learning and BrightBytes leverage predictive analytics to improve student retention and success rates (Brew et al., 2021).

6. AI in Content Creation

AI tools are also used to create and curate educational content. AI can generate personalized learning materials, quizzes, and even entire courses based on curriculum standards and student needs. Tools like Content Technologies, Inc. (CTI) and Quizlet's AI features exemplify how AI is enhancing the creation of educational resources (Contrino et al., 2024).

7. Virtual and Augmented Reality (VR/AR)

While not purely AI, the integration of VR/AR with AI creates immersive learning environments. AI enhances these experiences by adapting content based on student interactions within virtual environments. Tools like Google Expeditions and zSpace are pioneering this blend, offering interactive and engaging ways to explore complex subjects (Contrino et al., 2024).

AI technologies are reshaping education by providing personalized, efficient, and engaging learning experiences. These advancements offer significant potential to enhance educational outcomes and address individual student needs. As AI continues to evolve, its integration into education is likely to deepen, bringing further innovations and improvements to the learning process.

Benefits and Challenges of AI in the Education Sector

Artificial Intelligence (AI) is revolutionizing education by providing tailored learning experiences, automating routine tasks, and offering data-driven insights. While these advancements offer substantial benefits, they also present challenges that require thoughtful consideration.

Benefits:

1. Tailored Learning: AI facilitates customized learning by adjusting educational content to individual student needs. Platforms like DreamBox and Knewton use algorithms to modify math lessons based on real-time student performance, creating personalized learning paths that boost engagement and comprehension (Contrino et al., 2024).

2. Enhanced Accessibility: AI tools assist students with disabilities through features like speech-to-text, text-to-speech, and real-time translation. For instance, Microsoft's Seeing AI app aids visually impaired students by describing their surroundings and reading text aloud, significantly improving their learning experience (Brew et al., 2021).

3. Administrative Efficiency: AI can handle routine administrative tasks such as grading, scheduling, and providing student feedback. Tools like Gradescope utilize AI to grade assignments swiftly and accurately, allowing teachers to dedicate more time to interactive and impactful teaching activities (Taylor et al., 2021).

4. Increased Engagement: AI-driven educational games and interactive simulations make learning more engaging. The AI-based app Socratic, for example, uses visual explanations and interactive problem-solving to help students grasp complex subjects, enhancing their motivation and interest in learning (Contrino et al., 2024).

5. Data-Driven Insights: AI systems analyze vast amounts of data to provide insights into student performance and learning patterns, enabling educators to identify areas where students struggle and tailor their instruction accordingly. The AI-powered platform Squirrel AI uses data analytics to identify students' weaknesses and deliver targeted interventions (Brew et al., 2021).

Table 1. Benefits of AI in the Education Sector

	Aspect	Details	Example
(Contrino et al., 2024) Using an adaptive learning tool to improve student performance.	Personalized Learning	AI tailors educational content to meet individual student needs, which boosts engagement and comprehension.	Platforms such as DreamBox and Knewton adjust lessons in real-time based on student progress.
(Brew et al., 2021) A Literature Review of Academic Performance.	Improved Accessibility	AI enhances learning for students with disabilities through tools like speech-to-text, text-to-speech, and live translation services.	Microsoft's Seeing AI app aids visually impaired students by narrating their environment and reading text aloud.
(York et al., 2015)Defining and Measuring Academic Success.	Efficient Administration	AI streamlines administrative tasks such as grading, scheduling, and feedback, allowing teachers to focus on teaching.	Gradescope employs AI to quickly and accurately grade assignments.
(Contrino et al., 2024)Using an adaptive learning tool to improve student performance.	Enhanced Engagement	AI-powered educational games and simulations create a more interactive and engaging learning experience.	The app Socratic, driven by AI, offers visual explanations and interactive problem-solving opportunities.
(Brew et al., 2021) A Literature Review of Academic Performance.	Data-Driven Insights	AI processes data to reveal patterns in student performance and learning, enabling educators to customize instruction effectively.	Squirrel AI utilizes data analytics to pinpoint student weaknesses and deliver targeted support

Challenges

1. Privacy Issues The deployment of AI in educational settings raises major concerns regarding privacy due to the extensive collection and analysis of student data. Safeguarding this information and ensuring the confidentiality of student records is a critical challenge. An example of this is the debate over Proctorio, an AI-driven exam monitoring tool, which has raised significant issues related to data protection and student surveillance (Contrino et al., 2024).

2. Algorithmic Bias AI systems have the potential to reinforce and even amplify biases found in their training datasets, leading to inequitable treatment of different student groups. Research indicates that facial recognition technologies, for instance, tend to be less accurate for students with darker skin tones, which can result in unfair outcomes in AI-based educational tools (York et al., 2015).

3. Cost of Implementation The integration of AI into educational institutions involves considerable expense, encompassing technology, infrastructure, and training investments. Schools with limited funding may find these costs prohibitive, potentially exacerbating educational inequalities (Brew et al., 2021).

4. Teacher Training and Adaptation Effective use of AI tools requires that teachers receive proper training. The shift to AI-enhanced teaching methods can be difficult, necessitating continuous professional development and support. Resistance to new technologies may arise among educators due to unfamiliarity or a lack of confidence in utilizing these tools (Contrino et al., 2024).

5. Ethical Considerations The ethical dimensions of AI in education, such as the risk of excessive reliance on technology and reduced human interaction, are significant. It is essential to ensure that AI enhances the educational experience rather than diminishes it. Although AI tutors can offer tailored assistance, they cannot replace the emotional and critical thinking capabilities of human educators (York et al., 2015).

Table 2. Challenges of AI in the Education Sector

	Aspect	Details	Example
(Contrino et al., 2024) Using an adaptive learning tool to improve student performance.	Privacy Concerns	Utilizing AI requires gathering and analyzing extensive student data, which raises privacy issues.	The debate over Proctorio, an AI-driven exam monitoring tool, underscores worries about data security and student surveillance
(York et al., 2015) Defining and Measuring Academic Success.	Bias in AI Algorithms	AI systems may reinforce and magnify biases found in training data, resulting in unfair treatment of certain groups.	Research indicates that facial recognition systems are less precise for students with darker skin tones, potentially causing discrimination in AI-assisted educational tools.

	Aspect	Details	Example
(Brew et al., 2021) A Literature Review of Academic Performance.	High Implementation Costs	Deploying AI in educational settings demands substantial investments in technology, infrastructure, and training, which may be challenging for smaller or less funded schools.	Smaller or financially constrained schools may face difficulties in covering these expenses, possibly exacerbating the educational divide.
(Contrino et al., 2024) Using an adaptive learning tool to improve student performance.	Teacher Training	Effective use of AI tools necessitates comprehensive teacher training and continuous professional development.	Some educators may be hesitant to embrace new technologies due to unfamiliarity or lack of confidence.
(York et al., 2015) Defining and Measuring Academic Success.	Ethical Concerns	The ethical aspects of AI in education, such as potential over-reliance on technology and decreased human interaction, must be carefully evaluated to ensure that AI supplements rather than replaces the educational experience.	While AI tutors can offer personalized support, they cannot substitute the empathy and critical thinking abilities of human educators.

The integration of AI in education provides extensive benefits, such as tailored learning experiences and better student outcomes. However, to fully realize AI's potential, it is crucial to address various challenges, including data privacy, ethical issues, the incorporation of mechanical devices, guidance and upkeep, financial planning, and communication difficulties. Moreover, the high costs associated with these implementations, coupled with limited internet and communication access in some areas, create additional barriers.

List of Significant Market Players for AI in Education

The integration of artificial intelligence (AI) into educational settings is advancing swiftly, offering tailored learning opportunities, boosting student performance, and enriching the teaching process. Within this sphere, various key contributors have emerged, and we will outline some of the notable participants in the AI-driven education sector.

- **Amazon Inc.:** Amazon has a presence in education through its cloud computing services (Amazon Web Services - AWS) and Alexa voice assistant. AWS offers cloud-based solutions that can be leveraged by educational institutions for various applications, including AI-related projects (Amazon, 2024).
- **IBM**: IBM has been active in the field of education technology and AI. They offer various AI solutions for education, including personalized learning platforms and tools for educators to analyze student performance data(IBM, 2024).
- **Microsoft Corporation**: Microsoft has been integrating AI into its educational tools, such as Microsoft 365 Education, to enhance collaboration, communication, and personalized learning experiences for students and educators (Microsoft, 2024).
- **Aware**: Aware focuses on building AI-driven tools for education, particularly in the area of assessment and adaptive learning. They aim to provide personalized learning experiences for students through their platform (Saito & Aragaki, 2018).
- **Alphabet Inc.**: Alphabet is the parent company of Google. Google's educational tools and services, such as Google Workspace for Education and Google Classroom, often integrate AI features to assist teachers and students in various tasks(Alphabet, 2024).
- **Pearson Plc.**: Pearson is a well-known education publishing and assessment service company. They are exploring AI to enhance their educational materials and provide more personalized learning experiences(Pearson, 2024).
- **BridgeU**: BridgeU offers a platform that helps students in their university and career planning. They might use AI to match students with suitable educational opportunities based on their preferences and strengths(BridgeU, 2024).
- **DreamBox Learning Inc.**: DreamBox Learning provides an adaptive math program for students, which utilizes AI to tailor the curriculum to individual student needs(DreamBox, 2024).
- **Carnegie Learning Inc.**: Carnegie Learning offers AI-driven educational solutions, particularly in the field of mathematics. They focus on adaptive learning and providing teachers with tools to support their students effectively(Carnegie, 2024).
- **Nuance Communications Inc.**: Nuance Communications specializes in speech recognition technology, which could be applied in educational settings for language learning and accessibility purposes (GrandViewResearch, 2022).

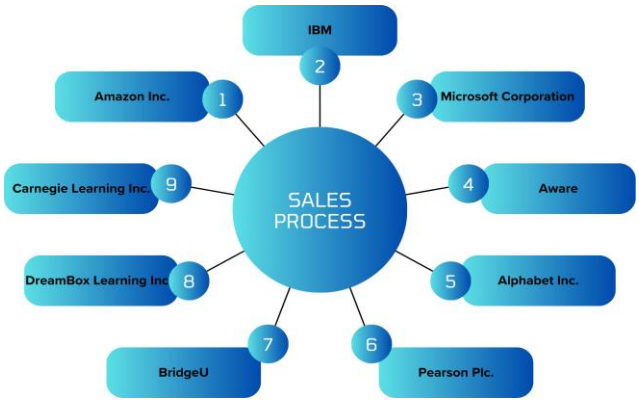

Figure 2. List of Significant Market Players for AI in Education

Valuable Applications and Opportunities for AI in Education

The potential of Artificial Intelligence (AI) to transform the education sector is immense, as it introduces cutting-edge solutions that can enrich educational experiences, streamline administrative tasks, and deliver customized assistance. Below are several key applications and possibilities for integrating AI into educational settings.

- **Virtual Reality Environment:** In the virtual reality world, computer-generated reality scenarios are frequently used to help players interact with various surrounding objects and features. Researchers predict that by 2030, these environments will be increasingly comprehensive and complex, allowing students to immerse themselves there to learn about topics from many different academic subjects. The remake of real and imagined universes would, in their words, "be as ubiquitous inside the research of the humanities as this of elective sciences," they predict (Evans, 2018).
- **Smart Campus:** Campuses are crucial for talent development, and a new trend in educational advancement is the application of AI technology to build smart campuses (Dong et al., 2020). For campus administration and services, AI is essential. In smart campus buildings, technology for face recognition, hearing, and sensing is employed (An & Xi, 2020; Zhou, 2020). The collection and analysis of massive volumes of data results in intelligent management systems (Villegas-Ch et al., 2019). Management and artificial intelligence work together to create a human-machine collaborative decision-making paradigm (M. Liu et al., 2018), which may more efficiently allocate resources, detect problems with the operation of the educational system in real-time, and enhance campus safety.

  Face recognition technology is used for identity authentication for dorms, labs, libraries, and other locations where access by non-school workers must be restricted to successfully deter questionable personnel from accessing (Afra & Alhajj, 2020). Simultaneously, facial recognition may aid in the prevention of card switching and unauthorized use of other people's credentials, so improving campus safety (Zhou, 2020). Moreover, facial recognition technology may be used to check out and return books from the library (Upala & Wong, 2019), finish identity verification using face data, and accomplish autonomous book borrowing and returning using the book lending and returning the machine, which increases library job efficiency and reduces personnel expenses. A camera installed at the checkout counter at canteens and campus supermarkets (An & Xi, 2020; L. Liu et al., 2018) can automatically recognize and compute the price of meals or commodities by image recognition (Ramdani et al., 2020), and face recognition is then utilized to facilitate checkout and self-service buying. To keep an eye out for intruders or students fleeing the building via the wall, infrared fences can be installed on school walls. When someone touches the infrared, the relevant person receives the information about the triggered alert and any on-site photos the camera captured in time to remind them to do site surveys or call the police (Muhamad et al., 2017).
- **Intelligent Tutoring Robots:** The development of tutoring robots has emerged from extensive interdisciplinary research, encompassing fields such as computer science, automated control, materials science, psychology, and optics. Initially, early robotics research focused on industrial applications (Grau et al., 2017). However, as robotics technology expanded, interest in its educational potential grew. The first instructional robot, created by Professor Papert at MIT's AI lab in the 1960s, marked the beginning of this evolution (Catlin & Blamires, 2018), (Ian Goodfellow, 2016).

  Purpose-built for educational contexts, these robots aim to enhance students' critical thinking, creativity, and practical skills. They are designed to be adaptable, interactive, open, and scalable (Miller et al., 2008). Tutoring robots utilize various AI technologies such as voice recognition, emotion detection (analyzing tone and facial expressions), and bionic technology (which mimics human-like actions and sensory capabilities) (Yang & Zhang, 2019). Intelligent teaching systems' potential to improve teaching efficacy and efficiency by offering individualized insights and recommendations based on data analysis is one of its most important consequences (Terblanche, 2020).

  The primary functions of intelligent tutoring robots can be categorized into five areas: robot-directed instruction, robot-assisted instruction, robot-managed instruction, robot-represented processes, and robot-

subject instruction (Hsieh et al., 2020; Spolaôr & Benitti, 2017). Research by Spolaôr & Benitti highlights the effectiveness of using robots for educational purposes, particularly in enhancing computer science education (Spolaôr & Benitti, 2017). Unlike traditional passive methods, these robots engage students by aligning with their interests (Belpaeme et al., 2018). For example, SoftBank's Pepper robot has been employed to teach various age groups and has been recognized for its ability to stimulate interest in AI through interactive learning (Eguchi & Okada, 2018). Additionally, robots developed by the University of Hertfordshire's Adaptive Systems Research Group have shown promise in engaging autistic children, indicating a positive response to robotic interaction (Wood et al., 2021).

- **Robotics in Education:** Several models have been launched to enhance several learning areas since Plaything developed its most recognizable mechanical technology products in the 1980s under the Mindstorms name. Students may develop their analytical and logical thinking abilities by building and programming their robots using Ozobot, Cubelets, or Dash and Dot. But if it can be demonstrated that instructional AI improves students' academic presentations while also motivating them, experts think it may find a home in the classroom (Brook, 2018).
- **AI Monitoring Framework:** Due to the introduction of particular, AI advancements like programmed discourse acknowledgment and regular language handling, the development of smart tutoring frameworks has sped from the research facility to $64,000 in utilization. These mental characteristics mentors use to direct education and practice in a variety of topics show their expertise. When a pupil stumbles in a particularly difficult circumstance, they provide them advice, give them timely feedback on their mistakes or reactions, and even design individualized learning programs for each understudy. Numerous innovative learning breakthroughs have been introduced as a result of its varied uses. For instance, the language-learning app Duolingo helps students advance at their speed and corrects students' errors as they are found. These sorts of tools "will become one of the hearts of the displaying approach in educating," in the opinion of experts, because they will aid in cost reduction by allowing a larger variety of pupils to receive individualized treatment and by facilitating faster connections with staff (Evans, 2018).
- **Research and Data Analysis:** AI can assist researchers in analyzing large datasets, identifying trends in educational outcomes, and conducting studies on effective teaching methodologies (Crompton & Burke, 2023).
- **Assistive Technologies:** AI assists students with disabilities through features like text-to-speech, speech-to-text, and image recognition, enhancing the accessibility of educational materials (Zdravkova et al., 2022).
- **Educational Data Analysis**: The advent of MOOCs and online learning platforms, serving as primary channels for data collection, has accelerated this field, which focuses on evaluating, gathering, and analyzing student data during the learning process. This collaborative effort could lead to significant advancements in knowledge and considerably enhance broad-based learning. AI researchers are now prioritizing studies in educational data analysis (Evans, 2018).

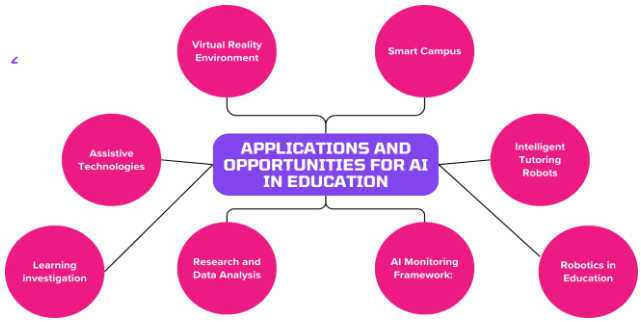

Figure 3. Applications and Opportunities for AI in Education

Discussion

Current Trends in the AI and ML Market for Education

The development of artificial intelligence enables businesses to use distributed computing, which lowers operating costs. It aids in sectioning online learning by making subjects efficiently accessible through various integrated applications namely creating virtual facilitators, logical websites, delivery tactics, and a variety of other things. The planning of AI and machine learning in the educational circle led to the delivery of cloud-based content, online tests, digital books, and many other devices. Virtual and enhanced reality is one of the most notable advancements brought on by AI and computerized reasoning. Numerous organizations and educational institutions use this outstanding innovation to explain lifelike proficiency in a variety of subjects, including history, science, geography, and others (Akkomplish, 2022). Thanks to this Augmented Reality (AR) / Virtual Reality (VR) technology, students had the choice to explore a variety of subjects through movements, photos, HD movies, and other media. Innovation is currently the most effective organization for academics and educators to foster profoundly reliable subject-situated skills.

The most notable developments made possible by AI and AI advancements in the education industry include flexible learning procedures, discourse recognition, and critical thinking systems. Thanks to AI and ML innovation, data personalization is easier. Huge amounts of data that were previously kept in books and registers are now transferred to clever systems that can record, evaluate, and provide useful experiences using more advanced technologies. Exams will be taken, moved, and reviewed by students from any location due to the circumstance in mechanical organizations. AI and technological advancements, such as speech recognition or augmented reality, can energize education in various open ways for children with special needs (Akkomplish, 2022).

Future Educational System Taught by AI

The geological districts do not have all the makings of being planning to be an exception for the ongoing change, as was recently noted, but AI has proactively laid out a solid foundation throughout the global school system. The Middle East has seen significant investments from domestic and international business sectors pouring in to advance its creative and technological achievements (Akkomplish, 2022). An important turning point for the Middle East's computerized economy was marked by Amazon's recent $580 million acquisition of a locally themed website. The Gulf States are resolutely developing 5G organizations, and the GCC nations have made it clear that they intend to encourage real improvements in carefully imaginative advancements (Akkomplish, 2022). There are projected to be sixteen Personality Factor Questionnaire linkages across all countries by 2025, which is significantly more than the global average. T

The development of new devices that can perform tasks like data filtering, handling, learning, artificial intelligence (AI), and microchip technology are aiding discourse acknowledgment, personalized learning, and other tasks. Overall, these developments might eliminate human mentors for AI-powered robots. Intuitive, targeted programming bundles will be created using VR and AR innovation to expand the scene of advanced stages. Students can use wearable technology to become familiar with a variety of educational concepts. This innovative innovation helps organizations evaluate students more quickly by reducing the time needed for actual tasks (Akkomplish, 2022).

The Future of AI For Education

ChatGPT (Chat Generative Pre-trained Transformer), an AI chatbot capable of producing human-like responses to various questions, is poised to revolutionize the teaching and learning process, becoming a prominent topic among educators and school leaders. Users have already tested the program, finding it capable of generating convincing essay responses and even publishable academic papers. Some believe students will benefit from understanding how such technology works and using it to explore the strengths and weaknesses of online information sources.

ChatGPT can aid teachers in streamlining their classes, enhancing the educational experience for students. It assists educators in crafting personalized lesson plans, answering student queries, and providing instant feedback on assignments. Additionally, teachers can use ChatGPT to create interactive quizzes, games, and other engaging activities to complement traditional teaching methods. By automating routine tasks like grading and feedback, ChatGPT allows educators to focus more on addressing individual student needs.

Embracing ChatGPT can enhance educational methods, offering a promising future for AI in education. This technology has the potential to transform our approach to learning, providing personalized experiences for students and robust tools for teachers.

Conclusion

Future advancements may see qualitative research techniques such as interviews, or quantitative approaches like online surveys, evolve to offer clearer insights and detailed conclusions. By leveraging AI, school administrators, teachers, and students can better identify and implement effective strategies to boost educational performance. Based on this analysis, it is recommended that educators and educational institutions worldwide, particularly in Ghana, adopt AI for its potential to transform learning experiences. This recommendation entails investing in essential technology and training to integrate AI effectively into classrooms. This could involve collaborations with AI firms, hiring AI experts, and creating customized AI tools and software. It is crucial, however, that AI does not replace human interaction or diminish the value of traditional teaching methods. Instead, AI should serve as a supplementary tool to enhance learning and provide personalized, data-driven insights into student performance. The review of AI advancements in education highlights the transformative potential of AI. Educators and institutions must embrace this potential and use AI responsibly and effectively to benefit students and enhance learning experiences.

Author Contributions

Conceptualization, A. S., G. B., B. B. B., and O. O. S.; original draft preparation, A. S., G. B., B. B. B., and O. O. S.; review and editing, A. S., and G. B.; supervision, A. S., G. B., B. B. B.,

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