Chapter 2 - Revolutionizing Education: Applications of Artificial Intelligence

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Chapter Highlights

> Artificial Intelligence is defined as a computer and software system used to solve problems that require human intelligence and to achieve human-like goals. In education, systems that perform human-like functions such as visual perception, speech recognition, decision-making, and translation are being developed.

> Artificial Intelligence plays an important role in education. It is used in areas such as smart teaching, language learning, and online education. In addition, institutions and projects focusing on AI education (for example, the Institute for Artificial Intelligence Systems of the Technical University Eindhoven) are being developed.

> AI is used to deliver personalized learning experiences, enhance practical training with virtual labs, and assess student performance. Virtual labs offer great advantages, especially for educational institutions with limited resources. AI-powered education can increase student engagement. It provides personalized feedback to students, can monitor attention levels, and adapt learning materials. This can help students to be more engaged and improve their learning outcomes.

> Artificial Intelligence can improve assessment processes in education. Facial and voice recognition technologies can be used to assess student engagement and understanding. Such tools can provide personalized feedback to students and optimize their learning experience.

Introduction to Artificial Intelligence

Computer and information science include artificial intelligence (AI). AI is used to construct hardware and software systems that solve problems and achieve goals that would normally require human intelligence (Moursund, 2006). AI is a conceptual framework for developing and using computer systems with human-like intelligence. These systems perform human-like functions, including visual perception, speech recognition, decision-making, and translation (Chen et al., 2020). AI research in computer science addresses cognitive difficulties related to human intelligence. These obstacles include learning, problem-solving, pattern identification, and adaptation. AI has historically been tied to computers, but embedded computers, sensors, and other technologies have enabled integration into buildings and robotics (Chen et al., 2020). AI has been used in education to solve problems and achieve goals. Examples include intelligent tutoring, computer-assisted language learning, and online education (Moursund, 2006). Language learning and teaching use AI to mimic teachers' and students' behavior. The content requires further details on AI's methodology and uses in this context. AI has unique characteristics and concepts and is closely linked to the future of higher education (Zawacki-Richter et al., 2019). Google and other non-profit public-private collaborations like the German Research Center for Artificial Intelligence have invested heavily in AI. Education AI application development and deployment are expected to rise. To promote artificial intelligence education and research, the Technical University of Eindhoven is developing an Artificial Intelligence Systems Institute (Zawacki-Richter et al., 2019). AI in education (AIEd) has a 30-year history. Zawacki-Richter et al. (2019) noted that educators must determine how to use AIEd to improve teaching on a larger scale. Ethical and pedagogical methods for employing AIEd in higher education need more investigation. Zawacki-Richter et al. (2019) also suggest a more critical review of AIEd's challenges and risks.

Advantages and Disadvantages of Using Artificial Intelligence in Education

Artificial intelligence (AI) in education is rising, potentially changing how students use educational materials. Wahyono et al. (2019) say artificial intelligence can assess a user's skill level and motivation to recommend models, media, and resources for personalized learning. This might improve learning by giving pupils personalized suggestions. AI-enabled virtual labs had a 90.8% accuracy rate in 2019. Virtual laboratories also benefit educational institutions with limited space and equipment, which hinders practical, hands-on learning. The benefits above suggest that AI-enabled virtual laboratories can adapt learning. However, virtual labs provide a one-way learning experience without user feedback (Wahyono et al., 2019). To address this constraint, tailor-made virtual laboratories using AI should be considered. This might improve learning results and make using educational materials easier for pupils.

How is Artificial Intelligence revolutionizing the field of education?

The practicality of using artificial intelligence (AI) technology in higher education has increased since its introduction (Malik et al., 2019). Uunona and Goosen (2023) say that using AI-powered online learning apps can potentially enhance student results. Furthermore, these applications can serve as a means to foster cooperation among different participants within the education system. The utilization of AI-based learning has the potential

to effectively tackle the obstacles encountered in the teaching and learning process. Furthermore, it may provide academic committees with enhanced decision-making capabilities, as highlighted by Malik et al. (2019). According to Malik et al. (2019), universities can efficiently utilize and modify technology to enhance learning outcomes and educational quality. According to Malik et al. (2019), using information and communication technologies (ICT) has significantly changed education. Moreover, integrating artificial intelligence (AI) can enhance the effectiveness and caliber of these technologies. Malik et al. (2019) suggested using a framework to make it easier to establish a thorough structure for implementing artificial intelligence (AI) in educational settings. This framework enables universities to effectively leverage their educational resources and enhance the quality of the learning experience provided to their students.

Most Popular AI-enabled Learning Solutions

The utilization of AI-enabled learning solutions is growing in several sectors, with a particular emphasis on accounting and finance. AI-enabled systems are built on the foundations of machine learning, expert systems, and perception. AI-enabled wargaming represents a notable instrument in the field, with deep reinforcement learning gaining increasing recognition and use. Numerous endeavors, exemplified by IBM Watson, are actively contributing to disseminating knowledge on technologies empowered by artificial intelligence. AI-enabled systems are also utilized in medical contexts, where supervised learning techniques are employed for categorization and diagnosis. Ethics and technological components play a significant role in developing AI-enabled systems (Aruleba et al., 2022). Moreover, the efficacy of AI-enabled services is heavily contingent upon the data with which they are provided (Rani & Suresh, 2021). For example, using artificial intelligence (AI) in in-store dialogues has enhanced the likelihood of attracting customers while reducing perceived intimidation (Saxena & Upadhyaya, 2023). Nevertheless, the consideration of safety has significant importance in the design of AI-enabled systems that are vital for safety. To guarantee these systems' security, many operational safety verification approaches have been developed (Lamrani, 2020). To deal with the problems of making soft AI-enabled systems, it is important to reevaluate common beliefs and thoroughly analyze the landscape of AI-enabled financial services (Ozkaya, 2020; Panday & Sergeeva, 2022). Furthermore, Elsayed and Erol-Kantarci (2019) have proposed a resource allocation strategy that enhances delay performance.

AI-Enabled Learning Solutions and Learning Outcomes

Artificial intelligence AI-enabled educational solutions represent a promising advancement in education, potentially significantly shaping the future of learning. According to the study conducted by Elsayed and Erol-Kantarci in 2019, the utilization of artificial intelligence (AI) in the context of wargames, as discussed by Schwartz et al. (2020), has the potential to enhance the design of military mission systems to optimize their results. According to Lin and Hazelbaker (2019) and Johnson (2022), using AI-enabled technologies, such as generating fabricated news, can potentially be employed for malicious intentions. Nevertheless, it has been suggested by Pandey and Sergeeva (2022) that they have the potential to improve the efficiency of financial services. Additionally, Rani and Suresh (2021) have highlighted their ability to boost the functionality of mobile phones. Furthermore, Saxena and Upadhyaya (2023) have indicated that they can also optimize operations inside physical

retail establishments. According to Hajishirzi and Costa (2021), using artificial intelligence (AI) can potentially enhance the overall consumer experience. Ali and Alhumaidi (2023) also assert that AI may improve medical diagnostics' precision, efficiency, and affordability, resulting in enhanced results. According to Aruleba et al. (2022), using AI-enabled gadgets and technology has promise for automating many daily tasks, including developing educational aids for children to enhance their learning achievements. Therefore, integrating artificial intelligence (AI) in educational tools can enhance learning outcomes by automating processes, optimizing performance, and improving the overall user experience.

Effectively Using AI-enabled Learning Solutions in Classroom

Ali et al. 2021 state that AI-enabled learning systems can provide pupils with a complete education. AI-enabled learning systems can teach students to recognize deep fakes. AI-enabled learning systems can help students identify and stop disinformation. Interactive games like "Created by AI or Not can help students understand AI-generated material. AI-enabled learning can teach students about generative models and deep fakes. Classrooms may develop synthetic media such as pictures, writing, music, colors, paintings, numbers, and movies. Classroom discussions could also cover AI-enabled learning systems' efficacy. Conversations can teach students about generative models and how realistic machine-generated media can be. Students may learn about AI technical applications like deepfakes using AI-enabled learning methods. AI-enabled learning solutions encourage media literacy in computer science curricula and technical literacy in K12 digital media sessions. AI-enabled learning solutions can also be employed in K–12 AI literacy curricula to tackle AI ethics. AI-enabled learning systems can address how changing technology affects knowledge distribution in media literacy programs. Digital literacy is complicated and requires sociology, politics, and technology. Social network bots, filter bubbles, and algorithmic bias may also be taught via AI. Whether or not it was AI-created, AI can aid student learning by provoking emotion and cognitive dissonance. AI-enabled learning solutions can challenge students' reality-based beliefs and inform them about generative AI's possible drawbacks. Teachers may employ AI-enabled learning solutions to educate students about complicated socio-technical systems and their ethical consequences. Students can also advise on AI-enabled technology regulations using AI-enabled learning methods. AI-enabled learning solutions may explain how distorted media affects social media information intake and diffusion. AI-enabled learning systems may also teach students about disinformation and its propagation. Students can comprehend difficult technological systems like GANs with accessible methods. Students can learn about technological systems' potential damage and critically analyze them.

AI-Powered Assessment Tools

AI-powered assessment technologies provide several benefits in the field of education. For example, using AI-powered educational dashboards has been shown to facilitate the development and evaluation of teaching augmentation strategies (Kulkarni, 2021). Furthermore, artificial intelligence (AI) based facial and vocal recognition technologies can potentially evaluate educational standards (Bhise et al., 2023). Yan (2023) has also suggested that chatbots powered by artificial intelligence can provide students with various educational services. The utilization of artificial intelligence (AI) in Massive Open Online Courses (MOOCs) has been significant in

facilitating the delivery of high-quality education to students (Chukwuedo et al., 2019). Moreover, implementing AI-driven autonomy in many fields has the potential to develop AI-driven scenarios that may assist nations in enhancing their educational systems (Brobbey et al., 2021). Furthermore, using AI-driven analytics enables nations to conduct comparative analyses and evaluate their benchmark advantages over other countries (Alkhalifah, 2023). AI-powered evaluation systems, such as AlphaCE Coaching & Education, which is based in Uppsala, have the potential to offer students personalized experiences with AI-driven autonomy (Eklund & Isaksson, 2019). Using AI-powered solutions can offer significant advantages to students, facilitating their access to high-quality education.

AI-powered Assessment Tools and Student Learning

According to Bhise et al. (2023), using AI-powered assessment tools enables the evaluation of student involvement and receptiveness. For instance, Bhise et al. (2023) demonstrated that facial and vocal recognition technologies could discern the level of concentration and comprehension exhibited by students about the topic being taught. Yan (2023) has also suggested that chatbots with artificial intelligence can assess students' language proficiency in real time. According to Chukwuedo et al. (2019), empirical studies have demonstrated that massive open online courses (MOOCs) enhanced by artificial intelligence (AI) have the potential to greatly facilitate the development of cooperation, communication, and critical thinking abilities. The use of AI-driven evaluation instruments has been demonstrated to be effective in assessing the implications of incorporating mobile learning (Brobbey et al., 2021). Additionally, these tools have been employed to forecast the identification of COVID-19 patients by analyzing chest X-ray pictures and coughing sounds (Shakira Fathima & Dilshad Begum, 2021). In addition, AI-driven technologies can investigate user-centric design and develop and evaluate solutions (Eklund & Isaksson, 2019). According to Akramov and Anvarjonova (2022), using AI-driven arbitrations and awards can enhance the efficiency and timeliness of dispute resolution by enabling decisions based on user preferences. In summary, using AI-powered assessment tools can significantly transform the landscape of student learning by providing customized, adaptive, and real-time feedback, enhancing the optimization of learning experiences.

Limitations of AI-powered Assessment Tools?

AI-driven evaluation technologies provide several benefits and constraints compared to conventional pen-and-paper tests. The utilization of artificial intelligence (AI) in facial and vocal recognition, as well as in massive open online courses (MOOCs), has played a significant role in offering suggestions that are tailored to students' academic achievements (Bhise et al., 2023). According to Kulkarni (2021), it is important to comprehend the technological challenges that might emerge throughout the evaluation procedure (Kulkarni, 2021). The study conducted by Chukwuedo et al. (2019) examines the impact of artificial intelligence (AI)-enabled Massive Open Online Courses (MOOCs) on the provision of high-quality education. Furthermore, it is worth noting that some businesses are now developing artificial intelligence (AI) systems or acquiring AI-powered software. However, it is important to acknowledge that these endeavors may expose these organizations to potential issues arising from data sensitivity or erroneous data (Silverman, 2020). In their study, Eklund and Isaksson (2019) thoroughly analyze and evaluate an autonomous system that uses artificial intelligence (AI). This system can effectively adjust

AI-based technical advancements to the art world's requirements and limitations. In their study, Suzuki et al. (2022) conducted a comparative analysis of AI-powered assessment tools and traditional paper and pen examinations, elucidating the respective merits and drawbacks of AI-powered assessment tools. Yan (2023) describes an artificial intelligence (AI)-enabled chatbot that can operate in real time while undergoing continuous assessment. Finally, Robbey et al. (2021) and Akramov & Anvarjonova (2022) have suggested that AI-driven arbitrators must evaluate both micro and macro-level social segments of consumers. In 2023, Valeria introduced Concurred, a content marketing tool driven by artificial intelligence (AI) technology. This product gives users comprehensive insights into AI-powered evaluation tools' functionalities, applications, and constraints.

AI-Based Tutoring Systems

Recently, AI-based tutoring systems have become popular and attempt to provide personalized teaching. These systems use artificial intelligence to analyze trends in students' responses and adapt to their learning styles, according to Hasse et al. (2019). Researchers have investigated combining AI-based systems with VR and other instructional technologies (Hasse et al., 2019). Interactive storytelling and command language systems research use AI-based instructional tools (Alofs, 2012). King et al. (2016) say AI teaching systems have helped spread the Internet and cell phones. These methods allow teachers to focus on struggling pupils, provide personalized instruction, and allow students to study at their own pace. However, AI-powered teaching has limits. Poor programming can cause errors. Students may also have different instructional levels than teachers. In conclusion, AI-based tutoring systems can help students. Before deploying AI-based tutoring systems, educators must fully comprehend their pros and cons.

AI-Based Tutoring Systems and Student Engagement

Tutoring systems driven by AI have improved student engagement. According to Hasse et al. (2019), increasing their engagement promotes learning and well-being. These systems can personalize learning and provide performance feedback, according to Hasse et al. (2019). Alofs (2012) has also studied integrating AI-based tutoring systems into traditional classrooms and online learning platforms. AI-based interactive storytelling systems can let students collaborate with AI-based education systems. King et al. (2016) suggest that AI-based tutoring systems reduce teachers' workloads and provide personalized instruction. AI-based tutoring systems may also identify student needs and provide personalized feedback, increasing student engagement. Thus, AI-based tutoring systems improve student engagement, learning, and well-being.

AI-Based Tutoring Systems and Student Learning

In traditional classrooms and online platforms, AI-based tutoring systems, or Intelligent Tutoring Systems (ITSs), are becoming more popular. These systems use machine learning algorithms to mimic student learning. They also let teachers customize the technology to their needs and methods. Information technology systems (ITSs) may also personalize education for individual learners by delivering information, assignments, and situations. AI-based teaching systems may be developed without AI programmers.

However, ensuring these systems are developed and implemented correctly is imperative to maximize their effectiveness. Additionally, continuous assessments are essential to identify instances where AI-based tutoring systems may produce harmful or erroneous outcomes. Furthermore, it is important to ensure that AI-based tutoring applications are developed with inclusivity, considering the various dimensions of diversity, such as gender, color, socioeconomic status, ability, and cultural background. The need for more transparency and comprehensibility regarding utilizing personal data in AI-driven tutoring systems poses issues in properly discerning emotional states and intrinsic motivation, giving rise to potential biases. AI-driven tutoring systems can discern the emotional state of students throughout their learning sessions, monitor their advancement, offer prompt guidance and feedback, and facilitate comprehension and application of the subject matter. It is critical to acknowledge that AI-based tutoring systems necessitate a comprehensive examination of learner requirements and may make erroneous assumptions regarding the student's learning process, as emotional states and intrinsic motivation play a crucial role in the efficacy of AI tutors. The extent to which AI can mitigate prejudice hinges upon the specific design of the AI instructor, given that previous instances have demonstrated biases within AI systems, resulting in adverse outcomes. Therefore, artificial intelligence (AI)-based tutoring systems significantly promise to mitigate prejudice and facilitate tailored learning experiences. However, it is important to regularly supervise the execution of these measures to verify their efficacy and prevent any potential misuse.

AI-Assisted Adaptive Learning

According to Xiao et al. (2021), AI-assisted adaptive learning combines AI with simulation to support one another. The objective is to develop an artificial intelligence (AI) model that may be utilized for power system model calibration, analysis, and control, as proposed by Xiao et al. (2021). Dynamic component modeling techniques using data-driven artificial intelligence models can achieve this goal. Artificial intelligence models can identify and articulate latent patterns inside the solution process, enhancing the effectiveness of the simulation. Moreover, the integration and simultaneous simulation of AI and physics-based models have been explored by Xiao et al. (2021). To develop an artificial intelligence model, it is necessary to possess a training dataset that comprises high-quality samples that accurately reflect the target population. The AI model is subsequently developed using a hypothesis set derived from the task and training data, as described by Xiao et al. (2021). The AI model is further trained using optimization techniques. Due to internal APIs, AI-assisted simulation is difficult to integrate into simulators. Xiao et al. (2021) recommends a learning simulation engine to make simulators AI-friendly. Simulation intelligence may revolutionize power system dynamic simulators. Simulation-assisted AI is essential for power system digital twins. The AI model created by AI-assisted adaptive learning may improve simulation precision and efficacy.

Benefits of AI-Assisted Adaptive Learning

AI-assisted adaptive learning is becoming increasingly prevalent. In many situations, AI-assisted adaptive learning can be beneficial. According to Nuhn (2021), tailored learning routes that match each learner's abilities, interests, and goals might be advantageous. Customized learning allows students to learn quickly and gain the

skills and knowledge they need to succeed. AI-assisted adaptive learning can also reduce school costs by eliminating the need for expensive physical resources and materials (Kalra et al., 2022). AI-assisted adaptive learning can also speed up skill development by providing personalized feedback and coaching. AI-assisted adaptive learning can improve learning by increasing engagement and involvement. AI's capacity to perceive and engage with learner emotions achieves this. These benefits make AI-assisted adaptive learning an appealing option for educational institutions and people looking to improve their learning experience.

Implementation of AI-Assisted Adaptive Learning in Classroom

AI-assisted adaptive learning in the classroom has proved effective (Nuhn, 2021). AI-assisted learning improves instructor and student learning, according to Xiao et al. (2021). The AI system uses vector and matrix classes to evaluate student aptitudes and preferences (Kalra et al., 2022). The system then adjusts the learning materials to the learner's speed. AI improves grading and exam accuracy and provides learner feedback. AI-assisted adaptive learning can also give students personalized learning paths, improving instructional planning and design (Nuhn, 2021). Teachers and students benefit from AI-assisted adaptive learning's improved grading, learning efficacy, and tailored learning trajectories. This strategy can provide a more effective and efficient classroom learning environment, according to Xiao et al. (2021). AI-assisted learning may also reduce Class 2 errors in schools (Kalra et al., 2022). This metric ensures the learner's development and maximum learning effectiveness.

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Citation

Taş, N. (2023). Revolutionizing Education: Applications of Artificial Intelligence. In A. Kaban, & A. Stachowicz-Stanusch (Eds.), *Empowering Education: Exploring the Potential of Artificial Intelligence* (pp. 21-30). ISTES Organization.