

Artificial Intelligence and the Sustainability of Educational Services: An Overview

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Abstract This article aims to provide an overview of the Sustainability of educational services in the era of Artificial Intelligence (AI). It displays the theoretical underpinnings of AI, its significance in education, prevalent applications, and the necessary requirements for ensuring the continuity of educational services within this AI-driven era. Adopting a descriptive approach, the article thoroughly examines AI and its impact on sustaining educational services, primarily through Arabic and English literature reviews and the analysis of relevant reports. It concludes by offering recommendations for exploring alternative methods to sustain educational services in the era of AI.

Keywords: artificial intelligence, sustainability, educational services

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1. Introduction

The contemporary era is undergoing a profound knowledge revolution known as the Fourth Industrial Revolution, seeking to bring extensive changes to human life by transforming machinery operations and altering thought processes. AI applications, a significant outcome of this revolution, are anticipated to bring about extensive innovations, becoming the driving force behind progress and prosperity. Governments globally are prioritizing the integration of AI into economic development strategies to capitalize on the vast information revolution [1,2,3].

AI applications encompass a variety of technologies and systems designed to replicate human intelligence, enabling machines to carry out tasks typically requiring human cognition. These include natural language processing for understanding and generating human language, machine learning for improving performance through data analysis, computer vision for interpreting visual information, robotics for autonomous physical tasks, and expert systems for emulating human decision-making in specialized domains [4]. Their significance lies in their ability to perform complex functions similar to human thinking, thereby enhancing organizational efficiency through task automation and comprehensive data analysis. Notable advancements in AI include various technologies and programs like expert systems, neural networks, genetic algorithm systems, intelligent agent systems, and fuzzy logic systems [5,6].

In the realm of education, AI is recognized as a crucial element in enhancing both teaching and learning procedures through individualizing experiences and aiding teachers. It assumes a pivotal role in assisting educators by

automating administrative duties, tailoring learning encounters, delivering real-time insights into student advancement, and facilitating instructional methods [7]. The implementation of AI applications has sparked substantial changes, granting students convenient access to digital materials and significantly contributing to enhanced knowledge acquisition. With the continuous evolution of AI technologies, their significance in education and training is anticipated to grow [8,9].

Several prior studies, including those by Tara [10] and Mahmoud [11], emphasize the importance of integrating AI applications like smart learning systems and virtual reality technology into school curricula. Additional research by Al-Awfi and Al-Rehaili [12], Abu Sweireh [13], and Al-Saidi et al. [14] underscores the significance of implementing AI in educational contexts, focusing on its impact on achieving educational objectives and enhancing students' learning abilities.

The 2017 European Union Summit emphasized the essential role of AI, launching the second digital educational plan. This plan aims to optimize the use of digital technology, encompassing diverse tools and platforms like online learning platforms, educational apps, digital resources, and interactive multimedia materials. It also focuses on developing digital skills and leveraging insights from European countries' educational experiences to improve education. This underscores AI's significant impact on both learning and teaching methods [15].

In the learning process, internet search capabilities have become crucial, replacing traditional textbooks with tablets. The anticipated transition from conventional classrooms to virtual classrooms facilitated by AI technologies, potentially involving the use of robots for routine tasks, aims to relieve teachers from activities like grading exams and evaluating assignments [6].

Given the inevitable impact of AI on the education sector, it is imperative to gain insights into the implementation of AI digital transformation and its effects on students' learning experiences. Equally important is examining the impact of this transformation on teachers, inspiring their love for work and professional growth.

The integration of AI in educational contexts raises fundamental questions about what and how to teach, the expected role of teachers, and the potential social and ethical implications of utilizing this technology.

2. Conceptual Framework

In the age of artificial intelligence (AI), there will be significant changes in teaching tools, methods of acquiring knowledge, and teacher training. Developing digital skills will be crucial for all educational programs, highlighting the need to master the ability to learn as technology advances rapidly and influences the job market.

The central focus of this research is on effectively utilizing AI applications to ensure the long-term sustainability of educational services. The article adopts a descriptive approach to deeply understand AI and its impact on sustaining educational services, primarily through reviewing relevant Arabic and English literature and analyzing reports.

The primary objectives of this article include recognizing the theoretical foundations of AI, highlighting its importance in education, identifying prominent applications in the educational realm, and discussing essential requirements for maintaining the viability of educational services in the AI era.

2.1. Concept of AI

Artificial Intelligence is a domain within computer science devoted to crafting technological systems and software capable of exhibiting intelligent behavior. The goal of AI is to develop machines that can learn from experience, make intelligent decisions, and execute complex tasks autonomously. AI plays a vital role in offering technological solutions that enhance learning experiences, deepen comprehension, and facilitate knowledge acquisition.

The term "artificial intelligence" emerged in the mid-20th century alongside the development of electromechanical computing. In 1956, John McCarthy, at a Dartmouth University conference, defined AI as "the science and engineering of making intelligent machines" [16]. Understanding human intelligence accurately is fundamental to the concept of AI, aiming to replicate it using computational methods [17].

AI encompasses a range of tools and techniques, including algorithms, neural networks, data mining, and machine learning, aimed at simulating human behavior [1]. Various definitions of AI exist:

- AI involves simulating human intelligence and understanding its nature by creating computer programs capable of mimicking intelligent human behavior [18].
- It is the science enabling machines to think like humans, essentially giving computers a mind [19].

- AI refers to machines capable of imitating various human intelligence functions, including perception, learning, problem-solving, linguistic interaction, and creative output [20].
- It is a branch of science and technology exploring human intelligence intricacies and striving to replicate them in machines to perform tasks intelligently [21].

In accordance with the context provided, AI can be described as a domain within computer science dedicated to creating systems and algorithms proficient in executing tasks usually associated with human intelligence. These tasks encompass a broad spectrum, ranging from natural language processing and machine learning to computer vision, robotics, and expert systems.

2.2. Goals of AI

AI, as an applied field within computer science, focuses on studying and replicating human intelligence. It aims to develop intelligent computers capable of performing complex tasks requiring deductive, inductive, and perceptive abilities. This interdisciplinary field draws from various scientific disciplines to understand human intelligence mechanisms, enabling computers to absorb human knowledge. Studies by Raghavi [6] and Khawalid [22] highlight AI's goal of creating systems capable of achieving or surpassing human-level intelligence by simulating intelligent human behavior.

According to Al-Saedi et al. [18], AI involves developing computer programs that can solve specific problems or make decisions within a given context using various inferential processes. The primary objective of advancing AI is to create computer systems with intelligence comparable to or greater than humans by incorporating human knowledge into them through knowledge bases. Utilizing software tools, computers can search these rules, conduct comparisons, and analyze data to extract optimal solutions to diverse problems. Al-Maliki [23] emphasizes AI's aim to enhance induction and reasoning principles, enabling applications to make decisions and solve problems even with incomplete data.

2.3. Significance of AI

AI applications are poised to significantly enhance performance across various sectors by minimizing reliance on human resources and ensuring uninterrupted operations, thus boosting productivity [24]. AI's capacity to undertake complex tasks comparable to human thinking enhances institutional efficiency by automating processes previously reliant on human labor, leveraging extensive data analysis capabilities [5].

AI's importance lies in its ability to transfer accumulated human experiences to smart machines, particularly in critical areas, mitigating risks associated with human work and enabling a focus on essential human-centric aspects. Additionally, AI facilitates the use of smart machines for challenging and perilous tasks, such as rescue operations during natural disasters. Its aptitude for handling intricate domains requiring continuous mental acuity and rapid decision-making underscores its significance. Moreover, AI expedites scientific

advancements, fostering faster growth and development in research fields [19].

In today's rapidly evolving world, acquiring essential skills is crucial for students to thrive in the 21st century. As technology advances, students need competencies such as critical thinking, problem-solving, creativity, collaboration, and digital literacy to succeed. Recent research underscores the importance of AI in preparing students for modern challenges and workplace demands. For example, Pallathadka et al. [7] demonstrate how AI-powered educational tools enhance cognitive skills and adaptability, preparing students for various professional settings. Similarly, Shahin [9] highlights AI's role in fostering innovative thinking and technological proficiency, aligning students' skills with contemporary workplace requirements.

2.4. Characteristics of AI

Khalida [25], Shaheen [9], and Raghavi [6] argue that AI possesses unique attributes that allow computer programs to mimic human mental abilities and operational patterns. According to Russell and Norvig [4], Artificial Intelligence (AI) displays several distinct characteristics that set it apart from traditional computing methods. These features encompass adaptability, autonomy, problem-solving capabilities, natural language processing, computer vision, robotics, and machine learning. Adaptability denotes AI systems' capacity to learn from data and enhance performance without explicit programming. Autonomy grants AI systems the ability to function independently, making decisions and executing tasks without continuous human intervention. AI excels in problem-solving by analyzing vast datasets, identifying patterns, and generating insights or solutions. Additionally, AI systems can comprehend and generate human language (natural language processing), interpret visual information from images or videos (computer vision), and autonomously or semi-autonomously perform physical tasks (robotics). Lastly, AI utilizes machine learning algorithms to enhance performance by recognizing patterns, making predictions, and adapting to changing environments. These attributes collectively enable AI systems to simulate human intelligence and undertake a broad spectrum of tasks across diverse domains.

2.5. Principles and Types of AI

The core principles of AI, as outlined by Ben Abed and Zaghoui [26], can be summarized into two main aspects:

Data representation: This principle involves presenting the problem to be addressed by formatting the data in a way that the computer can comprehend for processing. Effective data representation is crucial for the computer to grasp the problem and generate a solution.

Reasoning: This principle relates to the computer's capacity to explore available options, assess them against predetermined criteria, make deductions, and ultimately determine the most optimal solution independently.

Based on these principles and the functional abilities of AI, it has been classified into several types:

- **Narrow Artificial Intelligence:** This type is prevalent and involves the use of software focused

on addressing specific problems. While it may not encompass all human cognitive capabilities, examples like Deep Blue chess programs demonstrate its ability to solve particular tasks without self-awareness.

- **General Artificial Intelligence:** This type aims to develop machines capable of autonomous thinking and planning, resembling human cognition. The study of general artificial intelligence includes methods such as Neural Network Artificial, which seeks to replicate the neural network system found in humans.
- **Super Artificial Intelligence:** This type surpasses human intelligence and can outperform specialists in specific tasks. However, achieving this level of machine intelligence remains a goal, as humans are responsible for programming AI systems.

3. Benefits of Employing AI in Educational Settings

AI serves as a significant driver of sustainable development across various sectors by integrating modern technologies into individual and institutional management practices. Currently, many educational systems are actively integrating AI applications into teaching and learning processes to create innovative learning environments that help students adapt to technological advancements. AI applications in education can be broadly classified into three main areas: cognitive science, intelligent machine applications, and applications of natural interfaces. These areas can be integrated into school curricula and teaching practices to enhance the learning experience for students [14].

The incorporation of AI into education is a significant advancement that enriches the learning experience for students and enhances the overall efficiency of the educational process. The benefits of using AI in education, as outlined by Shehata [27], are notable:

- **Modernization of traditional systems:** AI facilitates the transition from conventional management systems to electronic ones, streamlining decision-making processes and enabling the identification of learning patterns through data analysis.
- **Tailored support:** AI enables personalized support for each student, allowing them to learn at their own pace based on their individual needs.
- **Improved learning experience:** AI provides a personalized approach to learning, enabling students to progress according to their unique styles and preferences.
- **Emotional monitoring:** AI assists in assessing students' emotional responses, helping to identify additional support needs and provide appropriate assistance.
- **Skill recognition:** AI can identify students' skills and capabilities, offering recommendations to enhance personalized learning experiences.
- **Problem-solving assistance:** Through data analysis and machine learning algorithms, AI can effectively provide solutions and recommendations for learning challenges.

The significance of AI is particularly emphasized in modern education, where its role is deemed essential and its applications should not be overlooked. Below are the key points underscoring the importance of AI and its diverse applications across every aspect of the educational process:

■ **For students:** According to several sources [5,9,18,23,25,28,29], intelligent technologies are significantly revolutionizing student education, enhancing efficiency and personalized learning approaches. The utilization of AI in student learning offers numerous benefits, including:

- Incorporating continuous and adaptable robots in education to foster the development of life skills and cognitive abilities.
- Providing personalized student support through AI technologies, including intelligent assistants that cater to their psychological needs, abilities, strengths, and weaknesses, thereby improving educational outcomes.
- Enhancing student learning experiences with AI-powered tools such as virtual and augmented reality, along with chatbots that provide round-the-clock support tailored to individual student requirements.
- Improving student assessment through AI, offering instantaneous feedback and progress analysis to identify areas of proficiency and areas needing improvement.
- Streamlining time-consuming tasks with smart technology, enabling students to complete assignments more efficiently, and bolstering language learning through interactions with chatbots.
- Assisting in identifying and addressing student challenges by providing precise and immediate feedback, and offering personalized learning experiences based on individual preferences.
- Supporting students with special needs through AI applications, such as text translation for those with visual or hearing impairments.

■ **For teachers:** According to various studies [9,18,23,25,28,30,31], AI has emerged as a significant enhancer of the educational experience for teachers, providing invaluable support in their instructional roles. The integration of AI into education offers several advantages for teachers, including:

- AI augments the role of teachers by facilitating the development of effective instructional models and ensuring the delivery of high-quality education, while still preserving the essential role of teachers.
- AI applications empower teachers by automating administrative tasks, freeing up time for more engaging activities such as content development and research.
- AI simplifies tasks for teachers by efficiently assessing exams and assignments, saving time that can be redirected towards student interaction and enhancing the educational experience.
- Proficiently trained robots can supplement expert teachers by offering personalized lessons and additional classes, addressing shortages in specialized areas.
- AI analysis of student performance data assists teachers in tailoring lesson plans and assessments to

individual students' strengths and weaknesses, enhancing teaching effectiveness and student engagement.

- AI tools improve presentation delivery and grading methods, enhancing efficiency in teaching practices.
- By embracing active learning facilitated by AI, teachers can transform their roles and motivate students to achieve higher academic results.
- AI enables teachers to customize support based on student needs, enhancing understanding of individual strengths and weaknesses.
- The integration of AI in education leads to personalized learning experiences and enhances teacher capabilities, ultimately improving teaching effectiveness and educational quality.
- AI allows teachers to focus on learning new methodologies and refining teaching skills by managing routine tasks more efficiently.

■ **For academic content:** Advanced technology, particularly AI, plays a significant role in continually improving and updating academic materials, as indicated by Siemens [32], Barrett et al. [33], Marzano et al. [34], Gligorea et al. [35], and Al-Maliki [23]. AI's impact on the development and enhancement of academic content spans various dimensions, including:

- AI enables customized learning experiences by tailoring content to individual student abilities and needs, thereby enhancing the learning process's efficiency.
- Through the accurate analysis of educational data and student behaviors, AI supports the refinement of academic content, ensuring it meets students' needs and addresses anticipated challenges.
- AI fosters diverse and engaging student interactions with academic content, promoting deeper understanding and concept comprehension.
- By analyzing student needs, strengths, and weaknesses and adjusting content accordingly, AI facilitates personalized learning experiences for each student.
- AI streamlines assessment processes, providing immediate reports and in-depth analysis of student progress, leading to enhanced understanding and timely feedback. Moreover, AI helps create study content tailored to individual student needs.
- Integration of advanced technologies like virtual reality and machine learning into academic content via AI enhances concept comprehension and elevates the overall educational experience.
- AI contributes to the efficiency of educational processes by providing accurate analyses and insights for improving teaching methods and integrating educational technologies.
- AI-driven educational content creation results in an individualized and responsive learning experience, adapting to each student's needs and understanding level.
- AI systems enable examination and analysis of curriculum pacing and student behavior, guiding students and recommending personalized learning approaches.
- AI applications equip teachers with tools to enhance interactive teaching skills, including assessing

students' knowledge levels and providing tailored exercises and tasks.

■ **For school administration:** AI applications have emerged as valuable tools for enhancing school administration performance and streamlining administrative processes, as evidenced by Makawi [31], Barrett et al. [33], Al-Subhi [36], Al-Hindawi and Ahmed [37], Khalida [25], Al-Saeedi et al. [18] Al-Maliki [23], and Fullan et al. [38]. The significance of AI in school administration is underscored by several key points:

- Enhanced decision-making processes: AI's ability to analyze vast amounts of data empowers school administrators to make informed decisions regarding educational policies and management, leading to improved school performance and sustainable educational advancements.
- Optimized resource allocation: AI assists school administration in accurately identifying resource needs and expectations, facilitating better budget allocation and investment planning for optimal resource utilization.
- Streamlined communication: AI facilitates efficient communication among stakeholders through organized communication systems and smart messaging platforms, enhancing collaboration between teachers, students, and parents.
- Identification of learning barriers: AI analyzes student behavior to identify learning challenges and tailor interventions to address individual needs, enabling administrators to design targeted support programs.
- Administrative efficiency: Automation of routine administrative tasks frees up management's time, allowing them to focus on critical aspects of school administration.
- Improved experience for teachers and students: AI enables personalized learning resources and support, enhancing comprehension for students and aiding teachers in refining their teaching methods.
- Streamlined file management: AI expedites file management processes and organizes documents efficiently, saving time and effort for school management.
- Robust data management: AI ensures secure data and knowledge management, protecting against data loss resulting from employee turnover.

■ **For classrooms environment:** UNESCO [39], Al-Masry [40], and Shaheen [9] highlight a shift away from traditional teaching methods towards integrating robots and AI technologies tailored to meet individual student needs in classrooms. This integration of AI-driven personalized services is expected to enhance students' learning experiences and academic achievements by accurately identifying their requirements and delivering tailored learning experiences. This transition aims to improve the effectiveness and enjoyment of learning, resulting in better academic outcomes. Moreover, according to the U.S. Department of Education's report [41], AI has the potential to significantly increase student engagement in the classroom through various means. For instance, AI-powered adaptive learning systems can personalize the learning experience, addressing students' specific needs, preferences, and learning styles. This

personalized approach fosters greater engagement by providing relevant and customized content and activities. Additionally, educational games and simulations based on AI, as suggested by Jiahui et al. [42], can enhance interactivity and enjoyment in learning, capturing students' attention and motivating them to actively participate in the educational process.

■ **For school libraries:** Recent technological advancements have led to the integration of AI, particularly intelligent robots, in school libraries, as evidenced by research conducted by Subaveerapandiyan [43] and Al-Sayed et al. [44]. AI plays a crucial role in modernizing and improving school libraries in various ways:

- Enhanced resource management: AI analyzes usage patterns and forecasts future needs, thereby enhancing library services.
- Tailored recommendations: AI provides personalized book and resource suggestions based on individual student preferences and academic levels.
- Improved search functionality: AI ensures accurate search results and delivers relevant resources, thereby enhancing the library's search capabilities.
- Efficient information analysis: AI assists librarians in organizing resources more effectively by analyzing information usage within the library.
- Support for decision-making: AI aids in selecting new resources and updating library collections, facilitating optimal decision-making for library administration.
- Advanced security measures: AI employs encryption and sophisticated security technologies to safeguard user information and maintain data confidentiality.
- Interactive learning experiences: AI introduces interactive applications and tools to enhance student engagement with the library.
- Research assistance: AI accelerates the extraction of relevant information for researchers, providing precise data analysis tools and research results.

In summary, AI empowers school libraries to offer improved services, enhance learning experiences, and achieve better outcomes for students and educational institutions. [53], AI technologies can be utilized to identify students requiring additional support and personalized interventions. AI-powered systems can analyze academic performance data, identify areas for improvement, and recommend targeted remedial resources and activities. Furthermore, AI can monitor students' progress in remedial programs and adjust interventions as necessary, thereby enhancing the effectiveness of these programs and assisting students in academic catch-up.

4. Applications of AI in Education

Research conducted by Al-Badou [45], Barsouli and Abdel Samad [46], Al-Sayed [47], and Shaheen [9] affirms that AI applications aim to replicate human cognitive processes. These smart learning systems, driven by AI technology, are structured around four primary models:

■ **Domain Model:** This model constitutes a fundamental aspect of AI-powered learning systems and educational AI applications. It enhances learning efficacy and aligns applications with user requirements. The Domain Model encompasses the following elements:

- Conceptual representation: Involves the depiction of cognitive concepts pertinent to the educational domain, encompassing educational terminology, subjects, and competencies.
- Conceptual relationships: Explicates the interplay among concepts within the educational domain, illustrating how educational terms influence student progression.
- Categorization and hierarchies: Organizes concepts into hierarchical or network structures, elucidating the relationships and interactions between various categories.
- Temporal context: Determines the temporal relevance of concepts, acknowledging that educational dynamics may evolve over time due to technological advancements.
- External factors: Encompasses external variables such as emerging educational technologies or evolving pedagogical trends, which may impact concepts within the domain.
- Future interactions: Offers insights into the anticipated interactions among concepts, enabling anticipation of future changes and requisite adaptations within the educational landscape.

■ **The Teaching Model**, a pivotal component of smart learning systems and AI applications, is focused on imparting educational content and guiding students toward achieving their learning objectives. It comprises several essential elements:

- Teaching methodologies: This entails identifying and formulating effective strategies utilized by educators to impart knowledge and facilitate student learning.
- Educational technology: This encompasses the integration of multimedia, smart applications, and online learning platforms to enrich the learning process.
- Personalized learning: Central to this concept is the customization of learning experiences to align with individual student needs. Personalization is based on student performance data, enabling the adaptation and modification of teaching methodologies accordingly.
- Content delivery: This involves the utilization of illustrations, educational videos, and real-world examples to enhance the clarity and efficacy of instructional content.
- Learning assessment: This aspect involves evaluating student comprehension and performance. Continuous assessment is employed to refine teaching strategies and tailor instructional approaches.
- Promotion of engagement: Encouraging active student participation and interaction, whether in traditional classroom settings or through digital mediums, is essential for fostering an engaging learning environment.

■ **The Student Model** is a fundamental component of AI-driven educational systems, focusing on comprehending and assessing students' performance and addressing their unique learning requirements. It comprises several key elements:

- Recording and evaluating performance: This involves capturing and assessing students' performance throughout their learning journeys, evaluating both comprehension and practical skills.
- Monitoring individual progress: The model tracks the progress of each student, whether it involves completing educational modules or enhancing specific competencies.
- Identifying educational needs: It analyzes students' educational requirements to pinpoint areas that necessitate reinforcement or further development.
- Tailoring the learning experience: Leveraging insights into individual needs and capabilities, the Student Model facilitates customized adjustments to the learning process, thereby enhancing its efficacy.
- Guiding students: The model provides direction to students, guiding them toward suitable resources and activities, while also offering motivation and support to cultivate self-motivation.
- Offering constructive feedback: Through the Student Model, constructive feedback on students' performance is provided, along with recommendations for improvement strategies.

■ **The User Interface Model** is centered around designing and refining the user interface to facilitate smooth interaction with the application, with the goal of enabling users to achieve their objectives conveniently. It encompasses the following key components:

- Crafting Graphical User Interface (GUI) elements: This involves developing visually appealing and user-friendly GUI components.
- Integrating advanced technologies: The model incorporates state-of-the-art technologies such as audio, virtual reality, and augmented reality to enrich the user experience.
- Ensuring prompt responsiveness: Efforts are made to guarantee that the application swiftly responds to user inputs, thereby enhancing user flow and comfort.
- Providing effective guidance: Users are skillfully guided throughout the application, with clear instructions and logically arranged interface elements.
- Offering customization features: Users have the ability to personalize certain aspects of the user interface according to their preferences.
- Improving user experience: The primary emphasis lies in delivering a positive and seamless user experience, ensuring that interactions with the application are efficient and enjoyable.
- Conducting regular assessments: The User Interface Model includes periodic testing and evaluation to uphold optimal performance and effectiveness.

Flasiński [48] and Khalida [25] have identified three main categories of AI applications aimed at directly enhancing the learning process. These applications harness advanced technologies within the AI domain to improve both individual and collaborative learning, ultimately enhancing the effectiveness and quality of the learning experience. These categories include:

- *Personalized tutors for individual learners:* These tutors utilize machine learning techniques and self-training algorithms, drawing from extensive datasets and neural networks to make informed decisions about educational content. An example of this is the iTalk2Learn platform, which focuses on teaching fractions by incorporating a learner model that stores relevant data about the student's mathematical knowledge, needs, and emotional state.
- *Intelligent support for collaborative learning:* AI systems play a vital role in facilitating productive collaborative learning through methods such as adaptive group formation, expert facilitation, virtual agents, and intelligent monitoring.
- *Adaptive group formation:* By employing AI techniques, pertinent information about participating individuals is gathered to form the most suitable groups for specific tasks, while also providing interactive support to collaborating students. This involves utilizing effective collaboration models and AI techniques to identify optimal strategies for collaborative problem-solving.

The utilization of AI in education encompasses various innovative applications that significantly enhance both teaching and learning processes. Drawing insights from relevant literature [3,8,10,12,13,44], notable applications of AI in education include:

- *Intelligent learning systems:* AI-driven smart learning systems analyze student data to understand their educational needs and tailor individualized learning plans accordingly.
- *Automated assessment:* AI-powered assessment systems swiftly analyze student performance and provide immediate feedback, facilitating continuous improvement and offering comprehensive progress reports.
- *Personalized educational content:* AI is utilized to generate customized educational content that matches students' needs and comprehension levels, leveraging analytics to recommend suitable materials and resources.
- *Educational assistance:* Interactive AI interfaces offer real-time support and guidance to students, with virtual assistants effectively addressing student inquiries.
- *Learning data analysis:* AI techniques analyze extensive student data to gain insights into their needs, anticipate learning trends, and identify future requirements, thereby enhancing educational processes.
- *Improved social interaction:* AI integration enhances student interaction, fostering communication and collaboration skills through interactive systems that facilitate cooperation among students.
- *Predictive analysis:* AI-driven predictive analysis utilizes student data to anticipate learning challenges, enabling targeted interventions to enhance student performance and address potential issues.

These applications underscore AI's pivotal role in education, bridging technology and learning to elevate the quality of education and enhance the student experience.

5. AI and Sustaining Educational Services

The International Conference on "Artificial Intelligence and Education," which took place in Beijing in May 2019, highlighted the importance of integrating technology and AI into the field of education. The conference emphasized the need for a human-centered approach when adopting AI technologies in education, aiming to enhance human intelligence, protect human rights, and advance sustainable development through effective collaboration between humans and machines in various aspects of life, learning, and work. Additionally, the conference identified five key areas for leveraging AI in education [39]:

- *Improving Education Management and Delivery:* This involves enhancing the management of educational processes using technology and AI.
- *Empowering Teaching and Teachers:* The focus is on empowering educators and improving teaching methods through technical tools and advanced technology.
- *Enhancing Learning and Teaching Assessment:* AI facilitates efficient and immediate assessment of students' performance and progress.
- *Developing Skills for the AI Era:* This entails cultivating essential life skills in students to enable them to interact effectively with technological advancements.
- *Providing Lifelong Learning Opportunities:* AI is utilized to offer continuous learning opportunities to individuals throughout their lives.

5.1. Requirements for Applying AI in Education

To ensure the sustainability of educational services amidst the prevalence of AI, it is essential to implement various measures and meet specific prerequisites for seamlessly integrating AI into the educational landscape. According to pertinent literature from UNESCO [49], Limna et al. [50], and Chen, Chen & Lin [51], as well as insights from Al-Maliki [23], Khalida [25], and Shaheen [9], several fundamental prerequisites must be fulfilled for the successful deployment of AI in the educational sector, including:

- *Technological Infrastructure:* Providing access to smart technologies and modern digital tools, supported by a high-speed internet network.
- *Staff Training:* Training teachers and staff to effectively use smart technologies and ensuring ongoing professional development.
- *Data Protection:* Implementing strict security measures to protect student and teacher data and adhering to privacy legislation.
- *Data Provision:* Safeguarding and providing high-quality educational data to benefit AI applications.
- *Software Development:* Supplying advanced educational software based on AI techniques and ensuring regular updates.
- *Financing:* Allocating sufficient funds for technological infrastructure, staff training, and software updates.

- *Effective Leadership*: Fostering leadership to support AI implementation and encouraging collaboration between educational leaders and technology specialists.
- *Ethical Controls*: Establishing guidelines to ensure ethical AI use aligned with educational values.
- *Communication and Partnerships*: Strengthening communication with industry and stakeholders to stay informed about technological advancements.
- *Continuous Evaluation*: Conducting regular assessments to evaluate the effectiveness of smart technology utilization and improve performance.

In summary, sustainable AI integration in education requires robust infrastructure, staff training, data protection, software development, financing, leadership, ethical controls, communication, partnerships, and continuous evaluation. These measures aim to enhance teaching and learning processes, ensure data security, and foster innovation in education.

5.2. Ethical Considerations in Applying AI in Education

When ethics are applied to education, they dictate the principles guiding the development and implementation of AI systems. These principles prioritize responsible and ethical usage, aiming to uphold human rights and values, minimize negative consequences, and maximize benefits. They also aim to address bias, promote fairness and transparency, and protect data privacy for all parties involved in education. To ensure the successful and ethical integration of AI in education [23,52], it is crucial to consider the following key ethical considerations:

- *Data Privacy Protection*: It is crucial to safeguard the data of students and educators to prevent unauthorized access or misuse.
- *Bias Mitigation and Equity*: AI algorithms should be designed to avoid bias, promoting equal and fair access to education for all.
- *Teacher Guidance and Professional Development*: Teachers should receive adequate training and support to effectively utilize AI techniques in education.
- *Balancing Human Interaction*: Maintaining a balance between technology and human interaction is essential, emphasizing the importance of strong teacher-student relationships.
- *Establishing Clear Learning Objectives*: Clearly defined objectives should be set to enhance the learning experience with the assistance of AI technology.
- *Implementing Clear Policies*: Effective policies must be implemented to ensure the ethical and efficient use of AI technology in education.
- *Strengthening Encryption and Security Measures*: Utilizing encryption and security technology is vital to protect data integrity and sensitive information.
- *Advocating for Algorithmic Transparency*: Transparency in the algorithms used by AI technology is essential to build trust and understanding.
- *Providing Ethical Training for Students*: Incorporating ethical training for students enhances

their awareness of the ethical implications of technology usage.

By adhering to these ethical considerations, AI can be effectively and responsibly utilized in education for the benefit of all stakeholders involved.

5.3. Risks of Applying AI in Education

The integration of AI in education holds significant promise for advancement and innovation. However, it is crucial to recognize and mitigate potential risks associated with this progress. Several studies [11,23,44] have outlined these risks as follows:

- *Employment Displacement*: Concerns arise among educators regarding the possibility of certain job roles being replaced by technology, leading to potential job loss.
- *Privacy and Security Concerns*: The extensive collection of student data raises worries about safeguarding individuals' privacy and the potential misuse of their information.
- *Bias and Inequality*: AI algorithms may inadvertently perpetuate biases present in historical data, affecting the fair distribution of education.
- *Social and Psychological Effects*: Over-reliance on technology in learning environments may diminish meaningful human interaction, hindering social communication and interpersonal relationships.
- *Financial and Technical Hurdles*: Implementing AI technologies requires significant financial investment and technical expertise for infrastructure development and staff training.
- *Exacerbation of Social Disparities*: Unequal access to AI technologies may widen existing social and economic gaps if not made available to all students equitably.

Addressing these risks and devising practical solutions is essential for the successful and sustainable integration of AI in education. Understanding these challenges and implementing appropriate measures underscores the importance of developing interactive strategies to overcome these obstacles and maximize the benefits of AI technology in education.

6. Recommendations

The paper suggests several requirements to ensure the sustainability of educational services in the AI era:

- *Integration of AI*: AI integration is crucial for improving learning outcomes and operational efficiency, involving the adoption of various AI-powered tools like learning platforms, tutoring systems, and adaptive assessments.
- *Identification of AI-Enhanced Services*: Specific areas such as personalized learning and adaptive assessment need to be identified for improvement through AI implementation.
- *Protection of Rights*: Ethical AI use should safeguard individuals' rights and privacy, adhering to data protection regulations and ethical considerations.

- Establishment of Standards: Advocacy for regulations promoting transparency, fairness, and accountability in AI education is necessary, requiring collaboration among stakeholders.
- Provision of Infrastructure: Adequate technological infrastructure and resources must be provided to enable effective AI utilization in educational institutions.
- Teacher Empowerment: Teachers should receive comprehensive training to integrate AI techniques into their teaching practices effectively.
- Awareness Campaigns: Stakeholders need to be educated about the benefits of AI applications in education to foster acceptance and support.
- Collaboration: Collaboration among educational institutions, the private sector, and research institutions is essential for developing and implementing AI-driven educational solutions.
- Curriculum Updates: Regular updates to curricula are needed to incorporate AI advancements, ensuring students are prepared for the evolving digital landscape.
- Data Security and Evaluation: Measures to safeguard data security and privacy should be implemented while continuously evaluating the effectiveness of AI applications in education.
- Funding Sources: Various sources, including governments, private investors, and philanthropic organizations, can provide funding for AI research and development.
- AI's Role in Assisting Underachieving Students: AI can assist underachieving students through personalized learning paths, intelligent tutoring systems, and adaptive assessments to improve learning outcomes.
- Enhancing Literacy Skills: AI offers tools like personalized learning platforms and language learning apps to enhance literacy skills, providing tailored content and interactive exercises for engagement and comprehension.

7. Conclusion

In conclusion, the integration of AI into educational services offers promising prospects for enhancing sustainability and efficacy in the realm of learning. Through AI-powered tools such as learning platforms, tutoring systems, and adaptive assessments, educational institutions can cater to individual student needs, promote personalized learning experiences, and optimize operational efficiency. However, alongside these advancements, it is imperative to address ethical considerations, data privacy concerns, and the potential impact on educational equity. Collaboration among stakeholders, including governments, educators, industry leaders, and learners, is essential to establish clear guidelines, ensure accountability, and foster responsible AI implementation in education. By embracing AI technologies responsibly and ethically, we can harness their full potential to drive innovation, improve learning outcomes, and ultimately, sustain and enhance educational services for generations to come.

References

- [1] Al Husseiny, F. (2023). Artificial Intelligence in Higher Education: A New Horizon. In S. Kaddoura (Ed.), *Handbook of Research on Artificial Intelligence Methods and Applications in Computer Engineering* (pp. 295-315). IGI Global.
- [2] Mu, P. (2019). Research on Artificial Intelligence Education and Its Value Orientation. Paper presented at the 1st International Education Technology and Research Conference (IETRC 2019), China, Retrieved from https://webofproceedings.org/proceedings_series/ESSP/IETRC%202019/IETRC19165.pdf.
- [3] Carlos RC, Kahn CE, Halabi S. (2018). Data Science: Big Data, Machine Learning, and Artificial Intelligence. *J Am Coll Radiol*. 2018 Mar;15(3 Pt B):497-498.
- [4] Russell, S. & Norvig, P. (2020): *Artificial Intelligence: A Modern Approach* (4th Edition). Pearson, Boston, ISBN 9780134610993.
- [5] Al-Mahdi, M.S.T. (2021). Education and future challenges in light of the philosophy of artificial intelligence. *Journal of Digital Educational and Learning Technology*, 2(5), 97-140.
- [6] Raghavi, K. (2023). The utilization of artificial intelligence in the education and health sectors. *Qanouk Magazine*, No. (17), 59-74.
- [7] Pallathadka, H.; Sonia, B.; Sanchez, D.T.; De Vera, J.V.; Godinez, J.A.T.; Pepito, M.T. (2022). Investigating the impact of artificial intelligence in education sector by predicting student performance. *Mater. Today Proc.* 2022, 51, 2264–2267.
- [8] Florea, A. M., & Radu, S. (2019). Artificial Intelligence and Education. 22nd International Conference on Control Systems and Computer Science (CSCS), 381–382.
- [9] Shaheen, H.A.M. (2023). Artificial intelligence and the shift from indoctrination to utilizing tools for sustainable education. *Arab Journal for Specific Education*, No. 26, 139-164. Retrieved from <http://search.mandumah.com/Record/1355921>.
- [10] Tarah, M.S. Rahman, Maryam Shawqi Abdel. (2020). Applications of artificial intelligence and expediting the process of digitizing education. *Iraqi University Journal Supplement, First International Conference, Digital Education in Light of the Corona Pandemic*, Damietta University, pp. 14-22.
- [11] Mahmoud, A.R.M. (2020). Applications of artificial intelligence: An introduction to developing education in light of the challenges posed by the COVID-19 pandemic. *International Journal of Research in Educational Sciences*, 3(4), pp. 171-224.
- [12] Al-Awfi, H.H.H.B., & Al-Ruhaili, T.A.F. (2021). The feasibility of utilizing artificial intelligence applications to enhance innovative capabilities in teaching mathematics to female secondary school students: Female teachers' perspectives in Medina. *Arab Journal of Specific Education*, 5(20), 157-202.
- [13] Sweireh, A.I. Salam, Ahmed. (2022). The effectiveness of teaching a proposed electronic unit on "Artificial Intelligence" to enhance programming skills among female ninth-grade students in the Gaza governorates. *Islamic University Journal for Educational and Psychological Studies*, 5(30), 57-106.
- [14] Al-Saidi, H.M.S., Al Balushi, F.A.M., & Al-Kaabi, M.S.M. (2023). The availability of artificial intelligence applications in social studies curricula in basic education schools in the Sultanate of Oman. *Journal of Curriculum and Teaching Methods*, 2(3), 1-14.
- [15] Iikka, T. (2018). The impact of artificial intelligence on learning, teaching, and education. Luxembourg: publications office of the European Union.
- [16] Monostori, L. (2014). Artificial Intelligence. In: Laperrière, L., Reinhart, G. (eds) *CIRP Encyclopedia of Production Engineering*. Springer, Berlin, Heidelberg.
- [17] Gherhes, V. (2019). Why are we afraid of artificial intelligence? *European review of applied sociology*. 11(17), 6-51.
- [18] Al-Sayyid, H.F., Abdel Hamid, A.M., & Al-Minshawy, M.A.S. (2023). Artificial intelligence and its social, media, and legal repercussions: A forward-looking vision. *Arab and Regional Horizons Magazine*, No. 13, 110-138.
- [19] Muqatil, L., & Hosni, H. (2021). Artificial intelligence and its educational applications to enhance the educational process. *Journal of Human and Society Sciences*, 10(4), Faculty of Humanities and Social Sciences, University of Biskra, Algeria, 109-127.
- [20] COMEST (UNESCO World Commission on the Ethics of Scientific Knowledge and Technology) (2019). Preliminary Study

- on the Ethics of Artificial Intelligence. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000367823>.
- [21] Zhong, Y. X. (2006). A cognitive approach and artificial intelligence research. 2006 5th IEEE International Conference on Cognitive Informatics, Vol. 1, pp. 90-100.
- [22] Khawalid, A.B., et al. (2019). Applications of artificial intelligence as a modern trend to enhance the competitiveness of business organizations. Book published by the Arab Democratic Center for Strategic, Political and Economic Studies, Berlin - Germany, first edition.
- [23] Al-Maliki, W.F. (2023). The role of artificial intelligence applications in enhancing higher education: A literature review. *Journal of Educational and Psychological Sciences*, 7(5), 39-701.
- [24] Al-Hadi, M. (2021). The impact of artificial intelligence and its effects on work and employment. *Journal of the Egyptian Society for Information Systems and Computer Technology*, 24, 14-32.
- [25] Khalida, M. (2023). Applications of artificial intelligence in the development of e-learning (digital education). *Arab Journal for Specific Education*, Arab Foundation for Education, Science and Arts, Egypt, January 7(25), 313-334.
- [26] Abed, B.F., & Zaghouli, O. (2022). The impact of Artificial Intelligence on individuals' functional aspect in the context of social change: A theoretical approach. *International Forum: Financial and Industrial Investment in Artificial Intelligence-Financial Technology and the Fourth Industrial Revolution*, Tripoli: Jeel Center for Scientific Research, 45-71. Retrieved from <http://search.mandumah.com/Record/1302195>.
- [27] Shehata, N.R.M. (2022). The employment of Artificial Intelligence applications in the educational process. Peer-reviewed scientific journal of the Egyptian Educational Computer Society, 10(2), 205-2014.
- [28] Borge, N. (2016). Artificial Intelligence to improve education challenges. *International Journal of Advanced & Innovative Technology (IJAEIT)* 2 (6), 10-13.
- [29] Ally, M. (2019). Competency Profile of the Digital and Online Teacher in Future Education. *The International Review of Research in Open and Distributed Learning*, 20(2), 302-318.
- [30] Naidoo, J., and Singh-Pillay, A. (2020). Exploring Mathematics Teachers' Professional Development: Embracing the Fourth Industrial Revolution. *Universal Journal of Educational Research*, 8(6), 2501 - 2508.
- [31] Makkawi, M.A.R. (2018). Artificial Intelligence at the forefront of education. *Al-Qafila Journal*, 67(6), 22-25.
- [32] Siemens, G. (2013). Learning Analytics: The Emergence of a Discipline. *American Behavioral Scientist*, 57(10), 1380-1400.
- [33] Barrett, M., Branson, L., Carter, S., DeLeon, F., Ellis, J., Gundlach, C., & Lee, D. (2019). Using Artificial Intelligence to Enhance Educational Opportunities and Student Services in Higher Education. *Inquiry: The Journal of the Virginia Community Colleges*, 22 (1), 1-10. Retrieved from <https://commons.vccs.edu/inquiry/vol22/iss1/11>.
- [34] Marzano, G., Abuze, A., & Nur, Y. (2021). Improving Adaptive Learning in a Smart Learning Environment. *TECHNOLOGIES. RESOURCES. Proceedings of the International Scientific and Practical Conference*, 2, 93-99.
- [35] Gligorea, I., Cioca, M., Oancea, R., Gorski, A.-T., Gorski, H., & Tudorache, P. (2023). Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review. *Education Sciences*, 13(12), 1216.
- [36] Al-Subhi, R.A.S. (2020). The reality of Najran University faculty members' utilization of Artificial Intelligence applications in education. *College of Education Journal of Educational Sciences*, 44(4), 319-368.
- [37] Al-Hindawi, A.A.F.H., & Ahmed, M.M.A. (2021). Artificial Intelligence and its applications in developing university administration: A proposed vision. *Education (Al-Azhar): A peer-reviewed scientific journal for educational, psychological, and social research*, 40(192), 477-513.
- [38] Fullan, M., Azorin, C., Harris, A., & Jones, M. (2023). Artificial Intelligence and school leadership: challenges, opportunities and implications. *School Leadership & Management*, 1-8.
- [39] UNESCO. (2019). Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development. Retrieved from: <https://unesdoc.unesco.org/ark:/48223/pf0000366994?posInSet=1&queryId=b33df4da-b7ce-424e-a8d9-e7bca8b2d142>.
- [40] Al-Masry, N.O. (2022). The role of Artificial Intelligence technologies in improving the quality of services provided to University of Jordan students: A student perspective. *Journal of the College of Education (Assiut)*, 38(9), 265-290.
- [41] U.S. Department of Education, Office of Educational Technology (2023). Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations, Washington, DC, 2023. Retrieved from: <https://www2.ed.gov/documents/ai-report/ai-report.pdf>.
- [42] Jiahui, H.; Saleh, S. & Liu, Y. (2021). A Review on Artificial Intelligence in Education. (2021). *Academic Journal of Interdisciplinary Studies*, 10(3), 206.
- [43] Subaveerapandiyan, A. (2023). "Application of Artificial Intelligence (AI) In Libraries and Its Impact on Library Operations Review". *Library Philosophy and Practice (e-journal)*. 7828. <https://digitalcommons.unl.edu/libphilprac/7828>.
- [44] Bakr, A.J. Sayed, Abdel. (2019). Artificial Intelligence: Policies, programs, and applications in higher education - an international perspective. *Journal of the Faculty of Education, Al-Azhar University*, 38(184), 383-432.
- [45] Bedouins, Abdullah, A.M. (2017). Smart learning and its correlation with creative thinking, as well as the most commonly used tools by mathematics teachers in smart learning schools. *Islamic University Journal for Educational and Psychological Studies*, 25(2), 347-368. Retrieved from <http://search.mandumah.com/Record/805454>.
- [46] Barsouli, F., & Samad, S.A. (2018). Utilizing technology to enhance the quality of higher education: An introduction to intelligent learning systems. *Forum Journal for Economic Studies and Research*, 4th issue/December 2018, 158-179.
- [47] El-Sayed, Y.M. (2021). Adaptive (smart) learning teacher competencies. *International E-Learning Association*, 1(2), March 2021, 55-88.
- [48] Flasiński, M. (2016). *Introduction to Artificial Intelligence: [E-Book]*. Cham: Springer International Publishing.
- [49] UNESCO. (2023). Guidance for generative Artificial Intelligence in education and research, UNESCO Digital Library. Retrieved from: <https://unesdoc.unesco.org/ark:/48223/pf0000386693>.
- [50] Limna, Pongsakorn and Jakwatanatham, Somporn and Siripattanakul, Sutitip and Kaewpuang, Pichart and Sriboonruang, Patcharavadee, A Review of Artificial Intelligence (AI) in Education during the Digital Era (July 2022). *Advance Knowledge for Executives*, 1(1), No. 3, 1-9, 2022, Available at SSRN: <https://ssrn.com/abstract=4160798>.
- [51] Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, 8, 75264-75278.
- [52] Akgun, S. & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI Ethics*, 2(3):431-440.
- [53] Yousuf, M., & Wahid, A. (2021). The role of artificial intelligence in education: Current trends and future prospects. In 2021 International conference on information science and communications technologies (ICISCT), Tashkent, Uzbekistan.

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