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Research paper



AI Tools in Building Sustainable Education

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Abstract

The article aims to develop the artificial intelligence concept as a key tool for shaping education for sustainable development. Using the system analysis and modeling conceptual AI methods as a complex social and economic phenomenon and dynamic process, the article considers ways of using risk assessment methods to identify potential threats and vulnerabilities associated with the AI implementation. These methods can be used both separately and in combination to conduct a deep and comprehensive analysis of the environmental security topic in the rapidly developing context of digital technologies. It is proven that education for sustainable development, in combination with innovative approaches, is a powerful tool for shaping the society of the future. Thanks to the use and modern technologies, education becomes more accessible, more effective, and contributes to the upbringing of a conscious generation capable of solving global goals and sustainable development challenges. Artificial intelligence should become a tool that will serve to train a highly professional and intellectual elite. The theoretical and practical research significance in developing the educational concept for sustainable development as a powerful tool for expanding the AI role, based on the innovative approach used and its implementation in the practice of educational institutions.

Keywords: *Artificial Intelligence; Education; Sustainable Development Goals; Innovation.*

1. Introduction

Artificial Intelligence (AI) is a powerful tool for achieving the Sustainable Development Goals in education. Its implementation contributes to improving education quality, ensuring knowledge accessibility, and stimulating innovative approaches to learning, which is consistent with the sustainable development principles. Sustainable development in education, ensuring high-quality, accessible, and inclusive education for all generations, by Goal No. 4 of the UN Sustainable Development Goals: "Quality Education". AI contributes to the implementation of this goal by creating conditions for individual learning, automating processes, and expanding access to knowledge on a global scale. AI has significant potential to promote the sustainable educational development, ensuring its accessibility, efficiency, and inclusiveness. At the same time, for the successful implementation of AI, it is necessary to take into account challenges such as digital. The development of artificial intelligence in 2025 will be diversified and intelligent. It is expected that by 2025, the global AI market will reach 190.6 billion US dollars, and the compound annual growth rate will exceed 40%. The integration of machine learning and deep learning, the quantum computing application, breakthroughs in natural language processing, and the multi-modal intelligent development will bring unprecedented changes and development opportunities to all aspects of life. It is expected that in intelligent manufacturing, AI will promote the optimization and flexible development of production processes, and the global intelligent manufacturing market will reach hundreds of billions US dollars; AI will also improve the credit scoring and forecasting market capabilities, as well as global finance. The technology market will reach tens of billions dollars. At the same time, the AI development is related to issues such as ethics, privacy, and social employment. Governments of various countries are actively formulating relevant policies and regulations to ensure the safe, controlled, and healthy development of artificial intelligence technologies. With its huge market and rich application scenarios, China is expected to become a key player in the global AI market by 2025. In the future, AI will continue to lead technological innovation and bring more opportunities to human society. As the concept of AI is promoted, unprecedented changes are taking place in advanced countries around the world. Machine learning (ML) and deep learning (DL), as the core technologies of artificial intelligence, are gradually realizing deep integration. Such integration not only improves the algorithm's performance but also opens up broader prospects for its application in various fields, including education.

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The literature review highlights the general trends in the evolution of digital technologies from the 4G to 5G era against the backdrop of challenges associated with digital globalization, as highlighted in the authors' work "Philosophy of Artificial Intelligence in the Challenge Context, Opportunities and Changes. [7] Globalization intensification has increased the accessibility and Internet speed, simplifying access to online resources, remote work opportunities, and the interactive learning environment. AI provides seamless real-time interaction between teachers and students in distance education, overcoming communication barriers. AI opens up new ways to provide education in remote or underserved regions, thereby changing educational technologies and transforming approaches to learning and collaboration in the online sphere. The integration of advanced teaching methods and technologies should be aimed at promoting intellectual and personal growth, which is facilitated by the approval of the Artificial Intelligence Development Concept in Ukraine.[5] Despite the obvious online learning advantages in higher education, the transition of educational processes to a distance format creates problems for both students and teachers. The emergence of 5G digital technologies promotes widespread distance education and the development of innovative forms in the digitalization context. The AI use of technologies allows to collect of significant data for the effective educational processes and adapting them to the students needs. Studies that are distinguished by an innovative approach to education emphasize the importance of information transfer, information, and communication technologies in the Industry 4.0 formation. The AI concept in education lays a scientific and methodological foundation for building a modern information system in the educational sphere and offers practical tools for studying the impact on global educational development.[2] Based on our own research [4], which focuses on modeling social cognitive development as a catalyst for digital transformation, we emphasize the network effect caused by the technological revolution, which provides real-time connectivity for all people. In this literature review, attention was drawn to the monography [3] where the authors try to create a new AI education theory, which requires the innovative technology integration crucial for innovative distance education. We explore innovative approaches to AI and new learning technologies, using modern information and telecommunication tools for effective AI implementation and predicting the prospects for further development. We highlight the modeling of distant learning processes that contribute to the individual learning environment creation an regardless of geographic location, while achieving the didactic higher education goals. [6]

In today’s environment, numerous innovative AI forms are using new technologies and methodologies to improve the learning quality and expand access to education. Therefore, it becomes imperative to learn from the pioneering educational institution experiences and explore technologies used by leading universities and organizations.[8] Virtual and augmented reality, particularly, contribute to an immersive learning environment where students interact with virtual objects and scenarios in real time using specialized platforms and communication tools. This approach includes adaptive technologies, mobile education, interactive video courses, and collaboration with high-tech enterprises, which contribute to more effective and accessible online learning. [1]

2. Literature review

The selection and analysis of literature sources was carried out according to the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which is an internationally recognized standard for conducting systematic reviews. This approach ensures transparency, reproducibility, and reliability of the research procedure.

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3. Methodology

UNESCO, in line with its comprehensive mission in education, science, culture, and information, has been focusing on issues related to artificial intelligence for the past 10 years. In November 2021, UNESCO helped its Member States adopt the world’s first normative framework on artificial intelligence ethics. In the educational field, UNESCO issued its first “Guiding Principles on Generative Artificial Intelligence in Education and Research” in September 2023, and in 2024, launched an AI competency framework for students and

teachers to analyze the AI development potential and risks. 13 years to use AI in classrooms. UNESCO also emphasizes that countries' investments in AI should leverage additional resources and not divert existing funds from education. Worldwide, one in four primary schools still lack electricity, and 60% of schools do not have access to the internet. Building well-managed and well-equipped schools, as well as forming a well-trained, well-paid, and purposeful teachers' team, should always be a priority as a basic needs. In the scientific and technological, artificial intelligence developed context in 2025 demonstrates unprecedented potential. To achieve the goal, the study used an interpretative and analytical method, which analyzed the concept of sustainable development of education, studied world experience, conceptualized the implementation of AI, and developed the main directions of its development through the use of general philosophical methods - analysis, synthesis, generalization, and systematization. The flexible methodology for studying the concept of sustainable development of education through the implementation of AI aims to increase flexibility and accessibility, especially for students in remote or hard-to-reach regions. AI technologies support the creation of virtual communities, promoting social interaction and collaborative learning. In addition, data analytics helps to track student performance and encourage active participation, using high-speed and reliable communication to facilitate global knowledge exchange and international collaboration. Ethical and legal considerations, such as data protection and equitable access, should underlie the development and implementation of these innovations. Overall, innovations in sustainable development education have the potential to change the learning paradigm and prepare students for the global world challenges.[7]

Constructivism is a pedagogical theory, paradigm, and methodology according to which knowledge is not transmitted in a ready-made form, but is formed by the learner in the process of active interaction with the environment, other people, and their own experience. As an epistemological paradigm, constructivism emphasizes contextuality, an activity-based approach, and social interaction as the basis of learning. In the digital age, constructivist principles naturally integrate with the potential of artificial intelligence. AI, acting as an intellectual mediator, contributes to: adapting educational content to individual needs; personalizing cognitive routes; reflective learning through analysis of user actions; and developing thinking through supporting project activities. Thus, constructivism in combination with AI transforms traditional learning into a dynamic environment focused on deep understanding, co-creation of knowledge, and active participation of the learner. Constructivism in educational technology promotes deeper student engagement, transforming the learning process into a dynamic, intellectually enriched environment in which AI acts as a learning partner to build sustainable education.

To achieve the goal, several interrelated methods were used:

Systematic literature review — according to the PRISMA protocol, a search, selection, and analysis of scientific sources in the Scopus, Web of Science, ERIC, and Google Scholar databases (2015–2025) was carried out. The selected sources were classified by topics: personalization, ethics, inclusion, cognitive technologies, and educational management.

Content analysis — for a qualitative analysis of the content of publications, including academic articles, reports of international organizations (UNESCO, OECD, UNICEF), as well as examples of practical implementation of AI solutions in different countries.

Comparative analysis — a comparison of the functionality and effectiveness of various AI tools (generative models, intelligent tutors, analytical systems), as well as their impact on key parameters of sustainable education.

Peer review — analysis of the ethical framework for the use of AI based on international recommendations (in particular, the UNESCO Recommendations on the Ethics of AI, 2021), with an emphasis on transparency, non-discrimination, confidentiality, and accountability.

Case study method — consideration of real examples of AI integration into education systems (for example, the use of GPT in virtual classrooms, adaptive platforms in countries of the Global South, analytics of educational outcomes in pilot projects).

The methodology is focused not only on identifying existing trends but also on forming a critical vision of the potential, risks, and limitations of AI in the educational context.

To study artificial intelligence tools for building sustainable education, the integrative method of artificial intelligence tools for building sustainable education was used — an approach that combines different AI technologies to create an educational environment that adapts to the needs of society, the economy, and the environment. This method aims to support an individual approach to learning, optimize resources, and improve the quality and accessibility of education. The goals of sustainable education using AI include inclusivity through providing access to quality education for all segments of the population, efficiency through cost reduction through automation of routine processes, flexibility in the ability to quickly adapt curricula to modern challenges, and environmental friendliness, which is manifested in reducing the use of paper, travel, and physical infrastructure.

Despite the growing role of AI tools in transforming the educational environment, the ethical aspects of their application remain relevant. Issues of data privacy, algorithmic bias, transparency of decision-making, and distribution of responsibility should be considered as key factors in the process of forming a sustainable educational ecosystem. In order to ensure a systematic and balanced approach to the ethical integration of AI, the principles enshrined in the UNESCO Recommendations on the Ethics of Artificial Intelligence (2021)[11] are appropriate. The aforementioned document constitutes a global normative framework that provides for the harmonization of technological progress with fundamental human rights. Among the main ethical principles that should be integrated into educational practices using AI, it is necessary to highlight: respect for the dignity, privacy and autonomy of the individual as the fundamental basis of technological interaction; ensuring inclusivity, non-discrimination and equal access to learning opportunities; environmental and social responsibility in the development and implementation of algorithmic solutions; ensuring transparency, accountability and explainability of AI systems as a necessary condition for democratic control. The integration of such approaches not only increases the legitimacy and public trust in educational innovations but also forms the basis for creating an ethically balanced, socially responsible, and sustainable model of education that meets the challenges of the digital age. [10]

4. Result and discussion

4.1. The AI role in promoting sustainable development of education: characteristics and challenges

Artificial Intelligence (AI) is becoming a key tool for achieving sustainable development goals in education, such as accessibility, inclusion, learning quality, and support for lifelong learning. Through the AI integration, the education system is changing, providing a modern approach to learning focused on solving global problems (On approval of the Concept for the Artificial Intelligence Development in Ukraine, 2021). Artificial Intelligence is a powerful tool for promoting the sustainable development of education. It provides learning, personalization, knowledge accessibility, and educational processes automation. However, the AI use is accompanied by challenges such as the digital divide, ethical issues, and high costs. Overcoming these challenges is possible through investments in infrastructure, digital literacy training, and the creation of international standards for ethical use. Based on constructivist learning theory, universal learning concepts, and depth of knowledge models, platforms have developed a multitude of learning tools. Its advantages are mainly reflected in

personalized learning, adaptation to different learning environments, and facilitating effective communication and collaboration. However, with the widespread use of learning tools, issues such as data privacy, technical bias, and user recognition are becoming increasingly prominent and need to be addressed in the advancing conceptual AI process. The artificial intelligence concept opens significant educational opportunities, and its use in universities must comply with clear ethical principles. To fully realize its potential, this technology must complement, not replace, the human and social learning aspects. Artificial intelligence should become a tool that will serve educators and students, the main purpose of which will be to promote their independence and well-being.

Artificial intelligence tools for building sustainable education. Building sustainable education in the 21st century requires the integration of innovative technologies, among which artificial intelligence tools play a key role. They can ensure inclusiveness, adaptability, and efficiency of the educational process while reducing the environmental and social burden.

Among the main tools, it is worth highlighting adaptive educational platforms that analyze the learning dynamics of each student and personalize content. Systems such as Knewton, Squirrel AI, or Century Tech use machine learning to build individual learning trajectories, increasing the efficiency of knowledge acquisition.

Generative language models, in particular ChatGPT, allow students to receive instant feedback, generate educational texts, explanations, questions, and even help in writing essays or solving problems. This not only contributes to the development of self-study skills but also compensates for the lack of human resources in underdeveloped regions.

Intelligent tutors (ITS), such as Alelo AI or Carnegie Learning, model pedagogical interactions, identify gaps in knowledge, and develop personalized learning strategies. They are particularly effective in environments with large numbers of students where personal support is limited.

Big Data-based analytics dashboards allow administrators and teachers to track performance, identify dropout risks promptly, and adjust curricula to meet current needs. Such solutions contribute to informed management decisions.

Language and translation AI tools—such as Google Translate with AI or OpenAI's Whisper—remove language barriers, enabling learning in multiple languages, particularly for refugees, migrants, or students from linguistic minorities.

All of these tools, when used ethically, form the basis for sustainable education that is inclusive, responsive, and socially responsible.

Table 1: The Role of AI In Promoting Sustainable Development of Education: Characteristics and Challenges

No, in order	Development direction
Ensuring education accessibility	• Online education and distance learning: AI-powered platforms (Coursera, Khan Academy) provide learning opportunities for people in remote areas and with limited access to traditional educational institutions. • Support for inclusive education: AI provides educational programs for people with special educational needs (e.g., speech synthesis programs, virtual sign language interpreters).
Learning individualization	• AI allows you to adapt the educational process to the needs of every student: analyzes progress, identifies strengths and weaknesses, and offers personalized tasks. • This approach promotes effective learning and reduces the number of students who drop out due to inequality of opportunities.
Automation of educational processes	• Automated systems for marking assignments, lesson planning, and performance monitoring allow teachers to focus on the creative aspects of their work. • Example: Using AI to automate test marking or curriculum organization.
Effective resource management	• Through data analytics, AI can help educational institutions allocate resources more efficiently, optimize class schedules, and predict supply needs. • This helps reduce costs and use resources more sustainably.
Environmental awareness development	• AI-based educational programs help build environmental literacy in young people through interactive courses, simulations, games, and virtual ecosystem models. • This encourages environmental awareness and sustainable lifestyles.
Supporting "lifelong learning"	• AI helps create lifelong learning systems for adults who want to update their knowledge or acquire new skills in a rapidly changing world. • For example, microlearning platforms allow you to learn topics on demand (such as programming or environmental management courses).
Monitoring and analysis of global educational needs	• AI can analyze data at the country or regional level to identify educational gaps and develop strategies to address them. This helps create policies focused on equal access to quality education.
AI characteristics as a sustainable development factor in education	• Adaptability: The ability to quickly respond to educational needs. • Accessibility: Ensuring equal access to knowledge regardless of place of residence or social status. • Innovation: Using the latest technologies to improve educational processes. • Efficiency: Optimizing education costs and rational use of resources. • Environmental friendliness: Using digital tools to reduce paper documentation and save natural resources.
Implementing AI challenges for the sustainable development of education	• Digital divide: Unequal access to technology between developed and less developed countries. . • Ethical aspects: Confidentiality of student data and transparency of algorithms. . • Cost of technology: High cost of implementing AI in educational infrastructure. . • Dependence on technology: Risk of reducing critical thinking in students due to the automation of educational processes.

(created by the authors).

Analysis shows that AI is a powerful sustainable development driver in education, contributing to its quality, accessibility, and efficiency. However, its implementation requires a careful approach, including overcoming the digital divide, ethical challenges, and social inequalities. The correct AI use in education can provide a significant breakthrough in achieving the global sustainable development goals. In 2025, artificial intelligence will bring an unprecedented personalized learning experience to the education industry. By monitoring and analyzing students' learning behavior in real time, an artificial intelligence system can select the most suitable learning plan for each student and help them better master knowledge. It is expected that by 2025, the global education technology market will exceed 342 billion US dollars, which will completely change the traditional learning model. [2]

Personalized learning development systems are inseparable from the synergy of machine learning and deep learning. By analyzing a large amount of student data, the system can identify each student's learning style, interests, and weaknesses to develop an individual learning path. For example, students who are good at visual learning will be offered more diagrams and videos, and students who prefer hands-on practice will be given more experiments and project tasks. This method teaches students according to their abilities, not only improving learning efficiency, but also stimulating students' interest in learning and creativity. In addition, AI will change the role of teachers. In the future, teachers will no longer be simply carriers of knowledge, but will also guide and support the learning process. With

the help of intelligent learning systems, teachers can be aware of each student's progress and problems, thereby providing more targeted guidance. At the same time, AI can also help teachers to correct homework and evaluate test results, which significantly reduces the workload on teachers and allows them to have more time and energy to focus on the overall students' development. [6]

The synthesis of constructivist approaches and the capabilities of artificial intelligence (AI) opens up new prospects for transforming the educational process towards more flexible, personalized, and active learning. One of the key areas is the personalization of learning, where AI analyzes the behavior of the student, their progress and mistakes, dynamically adapting the educational material to the individual style and pace of assimilation. This approach is based on the constructivist idea, according to which knowledge is not transmitted directly, but is constructed by the student himself in interaction with the learning environment - in this case, with an intelligent system. Another example of the implementation of constructivist pedagogy through AI is intelligent learning systems (ITS), which perform the functions of a digital tutor. Systems such as Cognitive Tutor or Alelo AI are able to diagnose gaps in knowledge, form individual tasks, and conduct a dialogue with the student based on the analysis of their actions. They not only transfer knowledge but also contribute to its active assimilation by involving the student in solving problems and forming new conceptual connections. A separate dimension of constructivism in digital education is represented by the "learning by making" approach, within which students independently create digital products — programs, models, or interactive objects — using AI tools. For example, the Scratch environment in combination with ChatGPT allows students to experiment, code, construct, and conceptualize their ideas through activity, which is a direct embodiment of Seymour Papert's ideas about developing thinking through creation. Finally, the concept of AI as a "mindtool" assumes that technologies do not replace teaching, but act as a means of supporting cognitive activity. In this context, AI performs the function of an intellectual partner that helps the student analyze information, ask questions, model knowledge, and reflect on their cognitive processes. Thus, the integration of constructivism and AI in modern education promotes the transition from passive consumption of knowledge to active creation, forming the basis for sustainable, flexible, and conscious learning.

4.2. Innovative approaches to the AI use in education and their benefits

Education for sustainable development (ESD) is a key tool for achieving a harmonious, environmentally safe, and economically efficient society. Thanks to innovative approaches, particularly the use of artificial intelligence (AI), modern education is being transformed, adapting to the challenges and sustainable development needs. Education for sustainable development is the foundation for solving global challenges, as it is aimed at forming environmental, economic, and social responsibility. It integrates knowledge about environmental, economic, and social problems, forming the skills of the younger generation for smart resource management, combating inequality, and sustainable development of the society. Education for sustainable development, combined with innovative approaches, is a powerful tool for shaping the society of the future. By that time, AI will find comprehensive application in many industries, such as healthcare, transport, and education. Advances in intelligent algorithms will make machine learning more effective, and automated decision-making systems will become more widespread. In addition, the artificial intelligence and the Internet of Things (IoT) will contribute to the further development of smart homes and smart cities, bringing great convenience and contributing to sustainable development.[4] Through AI and modern technology, education becomes more accessible, more effective, and contributes to the upbringing of a conscious generation capable of solving global sustainable development challenges (Table 2).

Table 2: Innovative Approaches to Using AI in Education and Their Benefits

Innovative approaches	The essence of the approach and how the process works	Examples and connection to sustainable development
Adaptive learning	Using AI to create personalized learning trajectories. AI systems analyze a student's individual needs, knowledge level, and learning style and suggest appropriate materials and tasks.	Platforms like DreamBox or Smart Sparrow that adapt content in real time. Adaptive testing that changes the difficulty of questions depending on the answers. Link to sustainable development - reducing the wasted time and resources on universal programs that do not take into account the individual needs of students.
Intelligent virtual assistants	Using chatbots and virtual tutors to support students and teachers. Virtual assistants answer students' questions, explain complex concepts, and organize the learning process.	Chatbots, such as ChatGPT, for quick access to knowledge. Tools that integrate into educational platforms, such as IBM's Watson Assistant. Link to sustainable development - ensuring access to knowledge in remote regions, reducing the burden on teachers.
Virtual and Augmented Reality (VR/AR)	Creating interactive learning environments that promote a deeper understanding of the material. Students interact with educational simulations or 3D models through VR/AR tools.	Virtual laboratories for studying chemical reactions or physical processes. Augmented reality in geography or biology (for example, studying the structure of the Earth or the human body). Connection with sustainable development - replacement of expensive materials (reagents, equipment) and conservation of resources.
Monitoring and analysis of educational data	Using AI to collect and analyze large amounts of data about the educational process. Analytical systems track student progress, predict learning problems, and provide recommendations for their elimination.	Learning Analytics tools in Moodle that analyze student performance. Link to sustainable development: Effective management of learning processes and timely support for students who are struggling.
Inclusive education	Using AI to develop learning programs for students with special needs. How it works: AI technologies such as speech synthesis, text recognition programs, and automated sign language translators.	Programs for blind students (tactile or voice interfaces). Real-time sign language translation tools (e.g., SignAll). Link to sustainable development: Creating equal opportunities in access to education.
Automation of teaching tasks	Using AI to automate test checking, scheduling, and curriculum creation. AI tools automatically check pa-	Turnitin and other academic integrity checking programs. Sustainability Link: Reducing teachers' time spent on routine tasks, contributing to improving the quality of education.

	pers, detect plagiarism, and analyze results. Teachers receive ready-made reports on student progress.	
Lifelong education	Creating platforms that allow people to continue their education throughout their lives. AI-integrated platforms offer courses that adapt to the level of knowledge and goals of students.	Coursera, EdX, with personalized course recommendations. Sustainability Connection: Supporting professional growth and reskilling in a changing labor market.
Creating environmental awareness through interactive courses	Creating educational programs that help raise environmental awareness. • VR environmental disaster simulations, sustainable development models, and courses on understanding climate change.	Programs for studying climate change. Educational games that simulate resource management. Connection with sustainable development: Fostering a responsible attitude towards the environment.
Advantages of innovative approaches in education	Accessibility: Education becomes more accessible to all, regardless of geographical or social status. Resource saving: Replacing physical materials with digital resources helps preserve the environment. Education quality: Individualized approach and accurate progress monitoring increase the effectiveness of learning. Promoting inclusion: Education becomes more inclusive thanks to tools for people with special needs.	Innovative approaches to AI use in education are a key factor in sustainable development, as they provide high-quality education adapted to modern needs, create equal opportunities for all, and contribute to the upbringing of a conscious generation capable of solving global challenges. The correct implementation of AI in education will help not only increase the efficiency of the educational process, but also make the world more sustainable and harmonious

(created by the authors).

Innovative approaches drive educational efficiency, as technologies such as artificial intelligence, virtual reality, and big data analytics make the learning process more efficient, interactive, and accessible. Innovative methods allow for tailoring education to the needs of a particular student, improving the learning quality and providing an individual approach. The AI use is expanding access to quality education, with online platforms using AI lowering barriers to education, especially for people in remote areas or with disabilities. Inclusive technologies provide access to education for people with special educational needs. Education becomes a fostering environmental awareness, as technology use (e.g., VR simulations) helps students understand the importance of sustainable living through realistic scenarios that demonstrate the irrational resource use consequences. Innovation in education contributes to "lifelong learning".[3] The modern world requires constant updating of knowledge and skills. AI tools, adaptive learning, and online courses support the concept of lifelong learning, which is the basis for sustainable development. The role of the teacher is transformed, as thanks to the automation of routine processes (checking tasks, monitoring progress), teachers can focus more on the creative and strategic educational component. Teachers become facilitators who help students develop critical thinking, environmental awareness, and social responsibility. Addressing the digital divide is critically important; education should be accompanied by efforts to overcome digital inequality. Ensuring access to technology for all segments of the population is a condition for achieving the Sustainable Development Goals. Innovation helps in the formation of global thinking, education for sustainable development in the context of innovative approaches forms global thinking in students, understanding the interdependence of world processes and the importance of cooperation between countries. [8]

The current evolution of AI — especially the emergence of generative models like GPT-4 — offers a paradigm shift in how education can be conceptualized and delivered. These technologies are not only capable of processing vast volumes of information but also of generating contextually relevant content, simulating learning scenarios, and delivering individualized feedback at scale. Their potential lies in the ability to align educational content with a student's cognitive profile, foster interactive learning environments through real-time data, and provide ongoing, conversational support that mimics real human tutoring.

Furthermore, generative AI opens new avenues for interdisciplinary learning, critical thinking development, creativity, and learner autonomy — competencies that are central to the future of education. Key directions for exploration include the integration of AI into learning management systems (LMS), the creation of ethical guidelines for responsible use of generative tools, and the design of transparent collaboration models between AI and educators.

In this light, the challenge is not merely to implement new technologies but to cultivate a holistic vision of AI as a collaborative agent in fostering resilient, future-oriented educational practices.

5. Conclusion

The theoretical artificial intelligence (AI) significance as a powerful tool for achieving sustainable development goals in education in expanding the scientific understanding of the AI education role, which is a new and important research object. AI helps to explain how digital technologies change the structure and learning methods; how AI algorithms affect pedagogical approaches and learning outcomes; how adaptive learning can ensure inclusion and educational personalization. Promoting the sustainable development theory in supporting the sustainable development concept through inclusivity (ensuring equal access to education); economic efficiency (resource optimization and cost reduction); development of global environmental awareness (creation of courses on environmental protection). Innovations in pedagogical science used thanks to AI allow the creation of new learning models that are based on automation, interactivity, and data on student behavior.

The practical AI use in education allows you to adapt educational materials to the student needs, help increase success through an individual approach, and reduce the time for learning. Online courses based on AI make education accessible to a wide audience, including people from remote regions or with limited physical abilities. Tools for inclusive education ensure the education of people with visual, hearing, or other special needs. AI takes over the test verification, monitoring progress, and creating lesson plans. This allows

teachers to pay more attention to the creative learning aspects. The AI use allows educational institutions to optimize resource management, for example, distributing educational materials, planning schedules, or predicting the number of students. Interactive courses using AI contribute to students' awareness of sustainable development and understanding of global environmental problems.

6. Practical recommendations

1) Develop adaptive learning platforms that take into account the individual student needs.
2) Use AI tools to analyze student progress and create personalized learning trajectories.
3) Introduce digital literacy courses for educators so that they can effectively use AI technologies.
4) Train teachers to apply innovative methods in teaching.
5) Create tools to support people with special needs (speech synthesis systems, sign language interpreters, etc.).
6) Ensure AI algorithm transparency and protection of students' data.
7) Expand access to the Internet and digital technologies in remote regions.
8) Introduce grants, scholarships, and programs to support innovation development in the educational field.
9) Set standards for the AI use in education to avoid discrimination and ensure equal access.
10) Master the digital tools and technologies necessary for learning in the modern world.
11) Use AI-integrated platforms to expand knowledge and improve skills.

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