

## THE ROLE OF DIGITIZATION OF THE EDUCATIONAL PROCESS IN THE CREATION AND FUNCTIONING OF ARTIFICIAL INTELLIGENCE

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**Abstract:** The authors assert that by improving instruction methods and reinventing learning experiences, artificial intelligence is already changing the educational environment for both instructors and students. It has been demonstrated that artificial intelligence disrupts conventional teaching and learning strategies, having a significant influence on contemporary education. Moreover, it is mentioned that gaining an understanding of AI-powered technologies' potential will make it easier to integrate them into the teaching process, improve instructional strategies, and automate administrative duties.

**Keywords:** digitization, artificial intelligence, technology, education, learning, ecosystem.

### 1 Introduction

The education system has to be updated and adapted in light of the global trends of the current day, including the digital economy and society. The primary goal of education is to educate students for professional and personal life in the VUCA and BANI worlds. Digital technologies have completely changed the way that education is delivered in academic settings, providing students with new ways to access, interact with, and apply information. The bounds of conventional education have been changed by technology, which includes interactive multimedia content, virtual classrooms, online learning platforms, and adaptive learning algorithms. In addition to improving learning's adaptability and accessibility, this digital revolution has made it possible for customized learning experiences that are catered to each learner's requirements and preferences [5-8; 13; 14; 16; 17; 35; 36; 44; 46].

The needs of the post-Covid-19 epidemic have been met by the smoothly connected school systems backed by technology across the world. The educational communities are also quickly acquainting themselves with the rapid advancements of digital technologies that are supported by artificial intelligence (AI) [24]. The smooth integration of digital technology tools into conventional learning environments characterizes the contemporary era's digital landscape, which has transformed education [19; 22]. This paradigm shift substantially alters students' ideas of individualized learning in the digital age and transforms how they engage with educational environments. Their ability to smoothly combine emerging personal learning environments with existing educational institutions, bolstered by AI-powered digital instructional technologies, is at the core of this change [45].

The integration of customized and adaptive learning experiences with conventional teaching-learning models is heralded by the introduction of AI technology in education. The conventional educational systems were teacher-focused and followed a set methodology for disseminating information in classroom settings [19; 23]. By offering a broad range of intelligent tutoring systems to adaptable learning platforms, artificial intelligence technologies catered to the specific demands and learning preferences of individual students [1]. This signals a change in strategy from a general to individualized instruction. Without

diminishing the advantages of the conventional social learning systems, it reshapes the educational landscape by establishing a setting where students advance at their own speed and receive tailored feedback, resulting in a more efficient and interesting learning experience [18].

Digitalization has been a major driver of innovation in classroom education during the past 10 years [43]. The next wave of innovation will be focused on artificial intelligence (AI) or integrating AI with other technologies; the majority of innovation to date has been focused on increasing the use of computers and the internet in the classroom. Since at least the 1980s, "AI in education" has been a coherent field of academic research, as evidenced by the founding of the International AI in Education Society (IAIED) in 1993 and the publication of the International Journal of Artificial Intelligence in Education in 1989. An artificial intelligence system is defined as a machine-based system that can make predictions, recommendations, or judgments influencing real or virtual environments for a given set of human-defined goals by the AI Group of Experts at the OECD in 2019. AI systems are designed to be autonomous to varying degrees. Artificial intelligence in society (2019) states that an AI system goes through the following phases throughout its lifetime: 1) planning and design, data collection and analysis, model creation and interpretation; 2) validation and verification; 3) deployment; and 4) operation and monitoring. One of the most promising AI strategies is machine learning (ML), which is characterized as a group of techniques that allow computers to learn automatically via patterns and inferences as opposed to by explicit instructions from a human [38].

All things considered, artificial intelligence is interwoven into a number of educational technology developments that offer learning analytics, recommendations, and diagnostic tools in a number of formats and for a number of purposes. AI applications are frequently still in their early stages of development and are not widely deployed at the system level; instead, they are implemented locally or in experimental settings. Nonetheless, there are a number of possible applications that hint to how artificial intelligence (AI) can alter education in the next decades and target a variety of stakeholders, including parents, educators, administrators, and students. Both in the classroom and at the systemic levels are instances of this. AI may be particularly useful in accomplishing SDG 4, which aims to "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" [33].

Inclusive education is one of the global goals included in SDG Goal 4, with the explicit objective of granting everyone, including those with disabilities, fair access to all educational levels. Artificial intelligence (AI) systems have demonstrated their effectiveness in helping people with disabilities - such as vision, hearing, or social skills (language and communication) deficits - complete their education. By enabling them to read books and recognize individuals, wearables with AI capabilities, for example, may help visually impaired students study and interact with others in their community. There are now systems designed expressly to support children with a range of disabilities. Students with physical and mental health limitations benefit from robotics, augmented and virtual reality (AR/VR), and other AI-powered technologies that facilitate their participation in class and study. Some of the difficulties can be overcome with the help of certain technologies, including text-to-speech or speech-to-text applications, while other approaches are supported by research and yield positive results. For example, kids with autism may explore and improve social skills in a school setting by interacting and cooperating with virtual characters and digital objects [33].

With the emergence of AI-powered digital learning technologies, education might undergo a radical transformation in the classroom as learning becomes more personalized, adaptable, and participatory. They enable students to get specialized

instruction, participate in collaborative learning with distant peers and teachers, and have access to a wealth of resources. These technologies are upending the status quo in education and facilitating more accessibility to lifelong learning than in the past by developing and growing.

The fusion of artificial intelligence and education heralds in a new era of learning. In response, Education 4.0 and digital education require an environment where artificial intelligence and digital skills converge [31]. This phenomena warrants in-depth investigation as it is causing a true paradigm change in education at all levels.

## 2 Materials and Methods

The methodological basis of the study was formed by the theory and methods of digitalization of education, the personal-activity approach to the analysis and evaluation of pedagogical phenomena, the personality-oriented approach to learning, as well as the development and use of intelligent systems. The methodology of the study is based on the use of the method of analysis and synthesis. The work also uses the systemic and dialectical approaches. In addition, the axiological approach directs the attention to the study of values as the meaning-forming foundations of the modernization of education.

## 3 Results and Discussion

Humanity is evolving from an information-based civilization to an intelligent society driven by artificial intelligence. Artificial intelligence (AI) has been the vanguard of human investigation into machine intelligence due to the rapid advancements in computer and information technologies in recent years [42; 47]. John McCarthy coined the phrase “Artificial Intelligence” in 1955, and since then, computational technology has advanced over the course of five decades, potentially leading to the creation of reliable computer-assisted learning systems [10]. The advent of Computer-Assisted Learning (CAL), which uses technology to personalize learning experiences, was a huge shift for educational systems [9]. Computer-assisted learning is now a vibrant, multidisciplinary subject with a wide range of issues and research possibilities because to the advancement of educational technology, digital devices, and machine learning applications [47]. CAL was more than just an instructional aid; it was a driving force behind the development of a generation that was engaged, adaptive, and digitally savvy, actively influencing the course of education in the future. With the introduction of AI technologies with deep learning to the CAL, learning content may be tailored to the specific needs of each student, resulting in improved comprehension and engagement through the use of interactive activities and multimedia that accommodate a variety of learning preferences. CAL uses internet channels to overcome geographical limitations during the Covid-19 epidemic, providing universal access to education worldwide [9].

The mandate of UNESCO mandates an approach to AI that is human-centered by nature. In addition to making sure AI doesn't further technical gaps inside and across nations, it seeks to change the debate to address present disparities in access to information, research, and the diversity of cultural expressions. “AI for all” must guarantee that everyone will be able to benefit from the ongoing technological transformation and enjoy its rewards, most notably in terms of knowledge and innovation.

Additionally, UNESCO created a book as part of the Beijing Consensus framework to help education policymakers become more artificial intelligence-ready. Practitioners and professionals in the policy-making and education communities might particularly benefit from reading UNESCO's paper “Artificial Intelligence and Education: Guidance for Policy-makers”. It attempts to create a common understanding of the advantages and disadvantages AI presents for education, as well as how it affects the fundamental skills required in the AI era.

In the upcoming years, there's a good chance that the fast development of artificial intelligence technologies will significantly alter the content of education and give rise to

entirely new digital learning resources and tools [12, 20-21, 26-29, 35-36]. The special potential of educational analytics based on intellectual data analysis should be taken into consideration when planning the use of AI in education. This technique can help to improve the quality of the educational process by predicting and identifying problems in the process of knowledge transfer and assimilation [40]. In certain nations, artificial intelligence (AI) and other digital advances have already shown to be beneficial in generating a whole new digital learning environment [11].

When discussing the relationship between the use of AI technologies in education and digital transformation, it is useful to discuss Rojas and Chiappe's research [37]. Digital ecosystems, according to the experts, are made up of a number of interrelated components that work together to provide a smooth and integrated digital experience. Artificial intelligence (AI) offers a lot of promise to enhance teaching and learning in the field of education. But in order to live up to the expectations around the use of AI in education, sufficient digital ecosystems must be created to support its efficient use. For this reason, it is crucial to have a deeper grasp of these ecosystems and the components that are essential to their implementation. A complex and dynamic environment made up of several linked parts working together to provide digitized educational experiences by exploiting AI capabilities is referred to as an AI-enabled digital educational ecosystem. In order to promote social interaction, collaboration, and communication among students, teachers, and learning communities, According to Giró-Gracia and Sancho-Gil [15], this calls for the efficient articulation of a number of technologies, including learning management systems, data, intelligent devices, apps, content, infrastructure, and users. These are the primary technologies of the fourth industrial revolution.

Okai-Ugbaje et al. [34] suggest a conceptual vision of new paradigm of digital (including AI-based) education, which they call m-learning (see Figure 1).

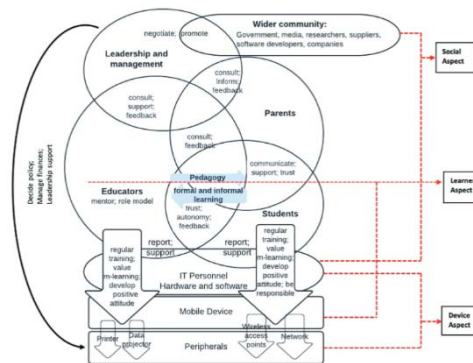


Figure 1. M-learning conceptual framework [34]

The assessment domain presents the most significant opportunity for transformative shifts in education using artificial intelligence. However, this is not appraisal in the conventional sense. AI-enabled exams use completely new tools and techniques than standard evaluations. Artificial Intelligence may lead to the replacement of traditional tests, which would need adjustments to educational practices. Unique and unusual artifacts employed in traditional assessments for summative, retrospective sampling include supply and choose response tests. On the other hand, artificial intelligence can assist recursive feedback networks, which are crucial to learning. Rather of employing sampling, the dataset may contain all recordable actions that occur during the learning process, such as using computer-mediated content resources, communicating with peers and instructors, and generating student work as knowledge representations [10]. Advanced AI models may create personalized, individualized learning paths by utilizing information about a learner's past, interests, and performance. AI can choose the best learning resources for each student based on their specific learning

preferences, increasing engagement and improving the educational experience.

Ruiz-Rojas et al. [39] claim that AI facilitates adaptive material distribution, active learning, and attendance tracking, all of which make virtual classrooms more user-friendly. AI improves instructional strategies, makes the most of instructional resources, and uses data analytics to enable data-driven decision-making. Furthermore, AI-powered learning management systems (LMS) are designed to streamline administrative tasks, customize learning paths, or offer real-time feedback [12]. By using AI-powered platforms, students may get timely feedback on their work in real-time that is contextually relevant. This helps them identify areas for improvement and makes rapid corrections. Rather than waiting for teacher input, this method shortens the time between learning and improvement cycles.

Although AI can directly help students create more efficient learning plans, the technology can also improve teachers' abilities. AI will benefit instructors and students alike by offering assistance across the educational system. Generative AI models have shown to be especially helpful for content creation and ideation. Interactive language models have the potential to expedite the development of preliminary lesson plans, practice worksheets, and homework assignments from an educational standpoint. The teacher can then modify and enhance AI's recommendations to provide a more customized and effective outcome.

Interactive technologies powered by AI are already showing their value in the classroom. More interactive games, adaptive simulations, and virtual laboratories are being developed to get students more involved in their schoolwork. These resources give educators effective new ways to educate, and elite universities now consider them standard equipment. A staggering 75% of respondents to a study by market research firm HolonIQ stated that the main justification for using AI is that it improves learner outcomes [4]. AI has the ability to greatly assist educators by enabling them to build solid curriculum foundations and customize instruction to meet the requirements of each unique learner.

AI-driven learning systems use data analytics to predict future learning patterns, guide the creation of curricula, and maximize the use of available educational resources. Educational institutions can improve overall educational performance, modify teaching approaches, and discover areas for growth by utilizing big data analytics [25].

Particularly in poor nations where traditional infrastructures may be weak, artificial intelligence has emerged as a transformational force in widening access to education. According to a number of case studies, AI-powered efforts have been crucial in democratizing education by offering creative ways to close the accessibility gap between students and high-quality learning materials.

For example, companies have deployed AI-driven systems in rural Asia and Africa to provide customized learning experiences based on the requirements of each individual student [33]. These platforms can adjust learning materials and procedures to maximize understanding and retention by evaluating massive quantities of data on student performance and behavior. This allows them to accommodate a variety of learning styles and abilities. These programs, which go out to remote communities with limited access to conventional educational institutions, have proven successful in giving students the tools and resources they need to pursue academic achievement regardless of geographic limits [32].

According to Lakshmi et al. [30], the United Arab Emirates (UAE) has taken the lead in the world in using AI and online education in recent years. Military universities have adopted this new technology, even though they still follow the conventional educational framework. Lakshmi's study examined the current acceptance rate, challenges, and solutions for putting in place an AI-powered online learning platform. The findings show that,

when supported by the institution, digital technology has a noticeable effect on every aspect of higher education. The findings also show that the organization is essential to the integration of digital technology into instruction and learning, and that understanding the possible impacts of new digital technology requires a critical analysis of the materiality that already exists within the Collaborative Technical Education (CTE) organization.

Artificial Intelligence is deliberately integrated into the educational system of Australia. The Australian Framework for Generative AI in Schools, in particular, aims to provide guidelines for the ethical and responsible application of generative AI technologies in ways that are advantageous to society, schools, and students. All parties involved in school education - teachers, administrators, support staff, service providers, parents, guardians, students, and policy makers - are supported by the Framework. The Minister for Education has endorsed a framework created by the national AI schools task group, which is why the decision to use AI in Australian schools was made. In an effort to reduce teacher workloads in Western Australia (WA), the Australian and Western Australian governments are working together on a co-funded pilot initiative that will include artificial intelligence into the education sector. The main objective of this AU\$ 4.7 million project is to decrease the amount of time teachers spend on lesson preparation and administrative duties by using AI technologies in eight chosen schools around Western Australia. By making these procedures more efficient, teachers will have more time to oversee lessons in the classroom, which will improve the students' overall educational experience. By automating different parts of lesson preparation and activity ideas, the AI technology used in this pilot program is designed to support instructors and make sure that these components are in line with the national curriculum. By using technology to handle most of the administrative work, this technology-driven approach hopes to free up instructors to concentrate more on teaching responsibilities and student interaction. The Workload Reduction Fund of the Commonwealth provides cash for the pilot program, and the Cook Government matches this amount. In addition, Western Australia's non-governmental education sector is funding the effort with AU\$300,000. The joint effort between various government levels and the education sector to alleviate teacher workloads through creative technological solutions is highlighted by this financial assistance [41].

The size of the global AI in education market is anticipated to increase from USD 3.6 billion in 2023 to about USD 73.7 billion by 2033, with a compound annual growth rate (CAGR) of 35.10% between 2024 and 2033 [2]. Figure 2 displays the market's statistical data.

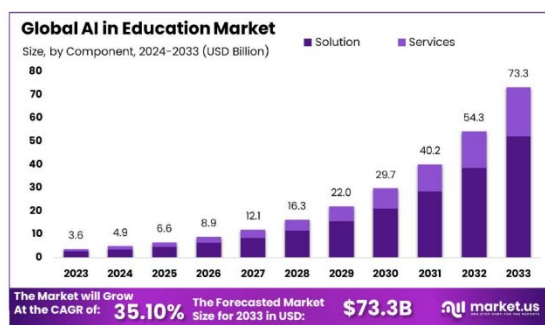


Figure 2. Global market of AI in education [2]

The industry is defined by the advancement of AI-powered products including virtual facilitators, intelligent tutoring systems, and intelligent content production tools. Strong digital infrastructure and encouraging government regulations are credited with the rapid adoption of AI technology in education in North America and the Asia-Pacific region. But obstacles like the digital divide, expensive implementation costs, and worries over data privacy might hinder industry expansion.

According to analysts, the market for AI in education has demonstrated promise and development that is encouraging. The successful fund-raising efforts of Chinese EdTech firm Squirrel AI Learning, which received \$150 million in 2022 at a value of \$2 billion, are among the noteworthy advances in the business. This sizeable investment shows that investors have a lot of faith in systems that use AI to drive adaptive coaching [2]. Studies suggest that AI-powered tutoring systems may boost student performance and engagement by as much as 30%. This is a remarkable effect of these systems. This beneficial result confirms even more the usefulness of AI in improving learning environments [2].

AI has the capacity to enhance understanding and help educators promote morality, judgment, and human dignity. One can explore new educational possibilities by integrating cutting-edge technology with timeless ideals. Furthermore, the creation of an "Ethics of Care" framework for AI in education depends heavily on cooperation between many stakeholders. Public education, policy recommendations, and targeted research are essential for guiding AI systems toward moral and ethical goals. The many viewpoints on AI in education highlight the importance of planning, common sense, and teamwork.

Work at the interface between technology and pedagogy centers around four key axes that together define the future of education. The sphere of educational revolution is covered by these axes, which include mobility, interaction, artificial intelligence, and technology learning aids like games and augmented reality [3]. The combination of these components demands the creation of a mobile-interactive paradigm that appropriately takes into account the learner's maximum convenience and temporal availability. At the moment, technology is already incorporated into the field of education. Its varied expressions in different settings, however, highlight how urgently these aspects must be combined and integrated into instructional frameworks that place a premium on students' knowledge. The understanding of the importance of intelligent tutoring systems, which democratize tutoring access, is fundamental to this paradigm. Learners may benefit from individualized and adaptable support, regardless of their location or socioeconomic background, by endowing these systems with sophisticated AI capabilities. It is also impossible to overstate the importance of technological experimentation since it opens up new avenues for research and enables for the application of discoveries to "teaching-learning models". These models make use of a wide variety of interaction patterns in order to improve learning. Educational frameworks may better meet the changing requirements of students by including these transformational aspects, and continual technology innovation and intelligent tutoring systems are key components in enhancing the educational process.

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**Primary Paper Section: A****Secondary Paper Section: AM**