Development Of Artificial Intelligence, Social Applications And The Strategic Role Of The Teacher In Education: Uzbekistan's Experience, Risks And Management Models

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ABSTRACT

This article provides a comprehensive analysis of the scientific debates surrounding the rapid development of artificial intelligence, its penetration into various spheres of society, the stages of the formation of artificial intelligence policy in Uzbekistan, institutional and infrastructural changes, and the possibility of artificial intelligence systems moving beyond human control in the long term. The main idea of the study is that the true value of artificial intelligence is not in its technical power, but in how it is managed in interaction with society, the state, and the education system. In this context, the article discusses the practical results of using artificial intelligence in healthcare, agriculture, public administration, finance, industry, and education, as well as negative consequences such as misinformation, algorithmic bias, shifts in the labor market, threats to privacy, cybersecurity, pedagogical dependence, and the weakening of human agency. In the case of Uzbekistan, the "Strategy for the Development of Artificial Intelligence Technologies until 2030" adopted in 2024, priority projects for 2025–2026, supercomputer and data infrastructure, the new legal environment formed in 2026, and the activity of the private sector are revealed based on modern sources. In the education section, the teacher is interpreted not as a replaceable subject of artificial intelligence, but as a strategic figure who sorts content, sets moral criteria, provides metacognitive guidance, and organizes real learning. The research was conducted using documentary-analytical, comparative, and scenario-based methods. The results show that the benefits of artificial intelligence do not arise automatically, but only when combined with human-centered management, strong pedagogical leadership, responsible regulation, and local scientific potential.

Keywords: artificial intelligence, Uzbekistan, digital transformation, algorithmic governance, pedagogical leadership, teacher competence, AI safety, generative AI, educational technologies, responsible innovation

Introduction

Artificial intelligence, as one of the most transformative technological phenomena of the twenty-first century, is no longer confined to the technical evolution of software systems, but has become a structural force reshaping the conceptual foundations of labor, knowledge production, governance, security, and social interaction. Originally associated with laboratory experimentation, expert systems, and narrowly defined computational tasks, AI has evolved into a pervasive socio-technical

infrastructure operating through natural language processing, computer vision, predictive analytics, recommender architectures, generative models, robotics, and semi-autonomous decision-making systems. The 2025 AI Index confirms that this transformation is accompanied by record levels of private investment, especially in generative AI, as well as by the rapid expansion of institutional adoption and social influence. Yet such acceleration cannot be interpreted exclusively through the lens of innovation and efficiency, because it simultaneously intensifies epistemic uncertainty, labor displacement, algorithmic bias, privacy erosion, cognitive dependency, manipulative content generation, and new forms of technological asymmetry. This contradiction is particularly visible in generative systems which, despite their remarkable ability to produce text, images, code, and analytical outputs within seconds, often conceal hallucinations, factual inaccuracies, contextual instability, and embedded bias behind an appearance of computational authority. Consequently, contemporary scientific debate is shifting from the narrow question of what AI can do toward the more consequential question of under what conditions, by whom, for what purposes, and within which regulatory and ethical boundaries it should be deployed. This problem is especially relevant for Uzbekistan, where AI has become part of a broader national modernization agenda linked to the digital economy, e-government, educational reform, agricultural innovation, and the expansion of domestic scientific capacity. The adoption of the “Strategy for the Development of Artificial Intelligence Technologies until 2030” on October 14, 2024, together with subsequent investments in supercomputing infrastructure, project portfolios, and legislative reform, demonstrates that AI in Uzbekistan is developing not merely as a technological trend, but as a political, economic, and educational project. Within this context, the key issue is not whether AI will matter, but how its growing power can be governed without undermining accountability, safety, and human agency, particularly in education, where the teacher remains not a replaceable figure, but a strategic actor responsible for ethical mediation, cognitive guidance, and the preservation of meaningful learning.

Materials and methods

The research methodology was based on a combination of documentary-analytical, comparative, interpretive and scenario-based approaches. In the first stage, internationally recognized conceptual and analytical sources were analyzed to identify general trends in the development of artificial intelligence: the Stanford HAI AI Index 2025 reports provided macro indicators on AI investments, the scope of business applications and technological pace the UNESCO Guidelines for Education and Research on Generative AI and the AI Competency Framework for Teachers defined a human-centered approach in education, teacher competence, rights and ethical criteria as methodological foundations the OECD Digital Education Outlook 2026 and policy documents on digital education highlighted the gap between the use of AI and real learning, the need for pedagogical orientation, professional development and systemic infrastructure. In the second stage, a comparative analysis of official regulatory, legal and political sources was conducted to reveal the context of Uzbekistan: Resolution No. PQ-358 and its annexes, priority projects for 2025–2026, presidential and government announcements, legal amendments regulating relations related to the use of artificial intelligence in 2026, as well as materials on the state's digital policy were reviewed. With the help of this analysis, the chronology of the formation of political attention to AI in Uzbekistan, priority sectors, infrastructure investments, deepening of the regulatory framework and institutional accountability mechanisms were clarified. In the third stage, evidence was systematized using UNDP materials from 2026 on the private sector, startup ecosystem, AI sandboxes and practical barriers - financial, technical, human capital and regulatory factors -. In the fourth stage, a risk-assessment approach was applied, and the “runaway” scenario was analyzed as a possible, but controversial and scientifically unsolved problem based on the international AI

Safety Report and related scientific discussions. The goal here was not to repeat the popular apocalyptic interpretation or techno-utopian denial, but to determine the epistemic status of the risk – that is, to distinguish between existing systems, developing autonomous agents and control mechanisms. In the fifth stage, the manuscript material "Yuldashov Barhayotjon Toshpulatovich article 5" submitted by the user was re-read as a content source, and its theses on the history and current state of Uzbekistan, application by sectors, negative consequences and policy recommendations were compared with external sources and clarified; that is, the manuscript was not used as a direct source for copying, but as analytical material that helped in selecting problem areas and compiling internal points for Uzbekistan. The obtained data were divided into five core blocks using content analysis, conceptual clustering, and thematic synthesis methods: the logic of development of artificial intelligence; its application in society and economy; the political and institutional situation of Uzbekistan; the problem of risk and control; the strategic role of the teacher in education. Then, three models were developed using the scenario interpretation method: the technocratic acceleration model, the uncontrolled diffusion model, and the human-centered management model. In the results and discussion sections, conclusions were drawn based on these models and clusters. Since this methodology is not a classic experimental design, but a theoretical-analytical and political-pedagogically oriented scientific analysis, its strength lies in its ability to combine different layers of sources - regulatory documents, international reports, educational recommendations, scientific considerations on security, and manuscript material on the national context - into a single interpretative framework. The limitation is that the article does not include a direct field survey or experimental testing; therefore, it should not be considered as a confirmatory statistical model, but as a conceptually, politically and methodologically in-depth scientific conclusion. Also, two criteria were strictly adhered to when selecting sources: the first is the time criterion, i.e. obtaining the latest normative and institutional data published in Uzbekistan in 2024–2026; the second is the reliability criterion, i.e. giving priority to official state portals, international organizations and scientific reports. Therefore, secondary information that is popular but poorly verified was not taken into account as a source of evidence, but only as a contextual observation. This approach served to strengthen the factual basis of the article and reduce speculative interpretations.

Results

The results of the analysis indicate that the contemporary development of artificial intelligence should be interpreted not merely as a technological advance, but as a complex socio-technical ecosystem formed through the interaction of data resources, computing infrastructures, algorithmic models, institutional capacity, regulation, and human competencies. Therefore, the real impact of AI cannot be measured only by accuracy rates, automation levels, or computational speed; rather, its practical value depends on governance quality, data reliability, organizational maturity, and user literacy. Sectoral analysis confirms that AI is already generating substantial but uneven effects across major domains. In healthcare, it improves medical image analysis, supports early risk detection, accelerates diagnosis, and optimizes resource allocation, yet these benefits remain vulnerable where inaccurate datasets, selection bias, and weak clinical accountability persist, since such conditions can produce misdiagnosis, erode trust, and reinforce an uncritical dependence on algorithmic outputs. In agriculture, AI contributes to crop-yield prediction, soil and moisture monitoring, drone-based observation, and the optimization of water and input use, which makes it especially important for Uzbekistan in the context of climate uncertainty, water scarcity, and the strategic necessity of increasing efficiency in land and resource management. In finance and banking, AI strengthens fraud detection, credit-risk evaluation, customer-oriented service design, and operational speed, but at the same time raises unresolved questions concerning data protection,

explainability, transparency, and the risk of algorithmically reproduced discrimination. In public administration, AI can accelerate service delivery, reduce bureaucratic procedures, improve application classification, detect problematic transactions at early stages, and expand predictive analytics, while simultaneously intensifying concerns related to privacy, citizen profiling, and opaque decision-making. At the general social level, generative AI has radically increased the speed of content production, but this has also amplified misinformation, synthetic manipulation, cognitive passivity, and the weakening of conventional criteria of authorship and authenticity. With specific regard to Uzbekistan, the findings show that AI policy has entered a more coherent and implementation-oriented phase. The 2024 national strategy defined the legal, technological, and economic framework for introducing AI into the economy and social sphere and established goals related to public services, laboratory expansion, server infrastructure, and the growth of AI-based products and services. The allocation of $50 million in 2025, the procurement of 16 supercomputers, the formation of 86 project packages, and the launch of smaller supercomputing capacities demonstrate accelerated movement on the infrastructure side. Government reporting further suggests that dozens of pilot initiatives have already been tested across public services, finance, security, and transport, while AI-related responsibility has been incorporated into sectoral and territorial governance structures. Uzbekistan's rise from 87th place in 2023 to 62nd in the 2025 AI Readiness Index also suggests that these efforts are visible not only in domestic policy discourse but in international measures of preparedness. In addition, initiatives aimed at creating a national AI model and training one million specialists indicate an increasing emphasis on local-language capacity, human capital formation, and digital sovereignty. Legislative reforms that entered into force in 2026 further confirm that the country is following a sequence of strategic planning, infrastructural strengthening, and legal consolidation. Materials concerning private-sector activity show that AI interest is growing in Uzbekistan, particularly among startups and SMEs in content generation, analytics, customer service, agritech, fintech, and healthtech, although significant obstacles remain in the form of limited financing, data-quality problems, shortages of qualified personnel, and regulatory ambiguity. A separate and especially important result concerns the issue of risk. While popular discourse often presents the possibility that AI may "escape human control" as an immediate and dramatic certainty, scientific literature adopts a more cautious position. The International Scientific Report on the Safety of Advanced AI suggests that current general-purpose systems pose a very low risk of genuine loss of control, whereas the long-term controllability of future highly autonomous systems remains an open and disputed scientific question rather than an empirically verified near-term scenario. This means that the issue should be treated neither as sensational panic nor as naïve dismissal, but as a matter requiring governance foresight, safety research, and regulatory vigilance. At the same time, the analysis identifies several immediate and already observable harms: weakening privacy protections, algorithmic injustice, the spread of synthetic falsehoods, compression of routine labor, digital inequality, and excessive user confidence in machine-generated outputs. The educational results are particularly significant. OECD evidence demonstrates that stronger task performance achieved with generative AI should not be equated with genuine learning, because without pedagogical mediation students may outsource their intellectual work to the machine and consequently become weaker in exams, transfer situations, and independent reasoning. UNESCO's teacher competency framework for AI, based on principles of human agency, professional rights, and sustainability, confirms that the teacher's role becomes more, not less, important in the AI era. On this basis, the most important conclusion of the article emerges: the fundamental question in education is not whether AI will replace the teacher, but how the teacher can be strengthened while preserving the student's independent thinking. Under these

conditions, the teacher becomes a strategic actor who selects and filters content, redesigns assignments, protects standards of truth and evidence, stimulates inquiry, and prevents students from confusing polished outputs with genuine understanding. The results also reveal a complex picture concerning labor and human capital. AI may automate routine tasks and reduce short-term demand in some occupations, but it also creates new roles such as data curator, AI ethicist, model auditor, prompt engineer, educational content designer, and human–AI interface moderator. This suggests that the key question is not simply whether jobs will disappear, but which competencies will increase in value and whether systems of retraining and higher education are prepared for that transformation. In the case of Uzbekistan, where the state has advanced the goal of preparing one million specialists, the issue is not only quantitative but methodological: without deep curricular design, such expansion may produce superficial platform literacy rather than robust analytical, ethical, interdisciplinary, and critical competence. Another important result concerns the distinction between efficiency outcomes and learning outcomes. AI can reduce administrative burdens, speed up feedback, personalize instructional materials, and support differentiated teaching however, where assignment design remains unchanged, assessment focuses only on final answers, and student reasoning remains invisible, AI may create the illusion of academic success while actually concealing shallow cognition and borrowed authorship. Therefore, AI produces immediate gains in efficiency, but authentic learning outcomes appear only where strong pedagogical mediation is present. The findings also identify regulatory sandboxes and controlled test environments in Uzbekistan as promising tools because they provide innovators with limited flexibility while allowing the state to monitor risks under real conditions. In this sense, the sandbox approach can serve as an intermediate mechanism between total prohibition and unrestricted deployment. Finally, the results show that the national language model initiative and the creation of local databases are transforming AI in Uzbekistan from a matter of imported technological use into a question of domestic knowledge production, linguistic relevance, public-service localization, and digital sovereignty. At the same time, the analysis reveals clear territorial and institutional asymmetries: large urban centers may benefit from laboratories, IT parks, specialists, and high-speed digital infrastructure, whereas peripheral regions remain limited by weaker connectivity, insufficient equipment, and a shortage of trained personnel and methodological support. This is especially critical in education, where AI can become a multiplier of opportunity in strong institutions but a multiplier of inequality in weak ones. A similar asymmetry exists at the linguistic and cultural level, because large language models are still disproportionately trained on English and globally dominant data, which can reduce semantic nuance, terminological precision, and cultural depth in local-language contexts. Therefore, the results suggest that national success in AI should not be judged by server power alone, but by the combined quality of governance, equitable access, educational preparedness, semantic adaptation, and culturally grounded localization.

Discussion

The discussion demonstrates that the most serious methodological mistake in approaching artificial intelligence is to interpret it through a simplistic binary logic, either as a universal solution to social and institutional problems or as an existential danger destined to overwhelm humanity. In reality, the social trajectory of AI depends less on algorithmic sophistication alone than on the quality of governance, the architecture of regulation, the reliability of information environments, the ethical maturity of institutions, and the adaptive capacity of education systems. The case of Uzbekistan clearly supports this conclusion. The country is moving rapidly in terms of strategic planning, infrastructure development, pilot projects, and personnel training, yet this very speed increases the need for legal certainty, audit mechanisms, data-quality standards, accountability procedures, and public trust. If infrastructures

and pilot deployments expand faster than the institutions capable of supervising them, AI may improve efficiency while simultaneously accelerating institutional error, making the condition of being "fast and wrong" potentially more dangerous than being "slow and wrong." For this reason, the legislative changes introduced in 2026 should be seen as only an initial stage; further development requires clearer criteria for risk classification, auditing standards, disclosure requirements, data provenance, human oversight in high-risk systems, and mechanisms of public accountability. International sources likewise confirm that AI safety is not only a technical question but an institutional one: in practice, the most common harms emerge not from speculative superintelligent agents, but from poor data, superficial deployment, distorted incentives, weak control systems, and irresponsible or underprepared users. Accordingly, although long-term discussions about the possible loss of control over advanced AI remain legitimate, they should not overshadow the immediate and already observable dangers of privacy erosion, discrimination, misinformation, weakened trust, pedagogical passivity, and unequal access. This problem becomes especially significant in education. Some technocratic narratives have advanced the idea that AI will replace teachers by preparing lessons, assessing performance, explaining material, and generating individualized learning paths. However, UNESCO and OECD materials, as well as basic pedagogical reasoning, demonstrate that such a thesis is reductionist, because real education is not equivalent to the mechanical transfer of information; it is a complex human process involving goal-setting, the calibration of difficulty, socio-emotional interaction, moral judgment, motivation, error-based growth, discussion culture, and reflective development. AI can certainly support some aspects of this process by generating differentiated exercises, accelerating feedback, sorting materials, visualizing concepts, offering examples, and reducing administrative burdens, but it cannot fully replace the teacher's professional judgment, sensitivity to classroom dynamics, capacity to detect a student's hidden logical barriers, or responsibility for the moral and civic dimensions of education. OECD findings especially emphasize that generative AI may help students complete tasks, but without pedagogical guidance it can also reduce cognitive effort and weaken the formation of durable knowledge. Therefore, the core paradigm should not be framed as "teacher versus AI," but rather as "teacher with principled AI." Within this model, the teacher performs at least three interconnected functions: first, as a technological moderator, deciding which tool should be used, when, and for what purpose; second, as an epistemic curator, verifying AI-generated outputs, identifying sources, applying standards of evidence, and training students to distinguish fact from interpretation and plausibility from proof; and third, as an ethical leader, protecting authorship, confidentiality, academic honesty, and digital justice within the learning process. Fulfilling such a role requires much more than operational familiarity with digital platforms; it requires competencies in AI literacy, data culture, prompt criticality, redesign of assessment, process-oriented learning design, and metacognitive dialogue with students. In the context of Uzbekistan, this means that AI preparation for teachers should not be treated as an optional add-on, but as a core element of professional development. Otherwise, schools and universities may turn into "digital showcases," where technology is visible but pedagogical management is absent. Another important issue concerns local language and data sovereignty. Initiatives aimed at building a national AI model and expanding Uzbek-language resources may strengthen cultural identity and technological independence, but they also impose greater responsibility for corpus collection, cleaning, ethical use, auditing, and quality assurance. A system does not become fair, secure, or reliable simply because it is local; these qualities must be produced through scientific scrutiny, openness of criteria, and broad expert participation. For this reason, the human-centered governance model proposed in the article rests on four interdependent pillars: infrastructure and data

quality, legal and ethical accountability, teacher and specialist preparation, and social transparency. Only the interaction of these four dimensions can ensure that AI produces sustainable public benefit; otherwise, technological acceleration may merely intensify preexisting inequalities and institutional weaknesses. In this sense, what is often described as the danger of AI "getting out of control" may in practice arise not from the machine itself, but from the delayed and fragmented response of human institutions. A further conclusion follows from this discussion: responsible AI governance cannot be achieved exclusively through top-down command structures. It requires multilayered governance in which the state provides strategic and legislative direction, sectoral regulators supervise high-risk applications, universities and research centers conduct independent expertise and methodological work, the private sector drives innovation, and teachers, journalists, and civil society exercise social monitoring and critical oversight. If AI policy remains monopolized by technical elites, public trust may decline if it remains limited to political slogans, innovation may stagnate. A balanced model therefore requires participatory regulation, sectoral audits, and open social deliberation. From the educational perspective, this also demands a rethinking of assessment. In AI-rich environments, abstracts, essays, and standardized tests increasingly fail to reveal a student's actual level of understanding. Assessment should therefore include process documentation, oral defense, staged writing, source verification, declaration of AI use, and reflective commentary. Under such conditions, the teacher becomes not merely a checker of final answers, but a guide and evaluator of intellectual development itself. Consequently, pedagogical systems should neither reject AI nor treat it as a digital savior. The more reasonable position is to approach AI as a cooperative instrument that can strengthen human labor while preserving indispensable human judgment. This is the theoretical core of the human-centered model advanced in the article. From this perspective, the teacher becomes not only an instructor, but also a guardian of digital justice. AI should be used to reduce gaps between stronger and weaker groups through differentiated support, while alternative methods must remain available where technology is absent or limited. Genuine pedagogical professionalism, therefore, lies in the ability to conduct meaningful learning both with AI and without it. A system dependent only on technology is not sustainable. Finally, teacher autonomy must also be protected: if AI platforms begin to determine lesson content, assessment criteria, and learning paths externally, the teacher risks being reduced from an intellectual creator to a mere operator. That is why UNESCO's insistence on teacher rights and human agency remains fundamental. In this respect, the true criterion for introducing AI into education is not how many platforms have been adopted, but how far teacher judgment, student independence, and ethical responsibility in education have been strengthened. Only under such a criterion can digital modernization become genuine pedagogical development.

Conclusion

In conclusion, while the development of artificial intelligence is providing a strong impetus for the development of society, its positive results come not from the technology itself, but from the culture of its management, regulation and targeted application. In the case of Uzbekistan, strategic decisions, supercomputer and information infrastructure, pilot projects, private sector activity and a new legal environment indicate that the country has entered an accelerated phase in AI. However, technical investment alone is not enough for the sustainability of this process; along with it, audit, transparency, accountability, data quality, ethical standards and human capital development become mandatory. Concerns about runaway control are neither scientifically completely unfounded nor a foregone conclusion; they are an open risk area that requires careful and in-depth research into future highly autonomous systems. But the immediate threats—disinformation, algorithmic bias, cybersecurity, labor market shifts, and cognitive dependency in education—are already demanding management measures.

In education, the main conclusion is even clearer: AI will not replace the teacher, but rather complicate and strategize his or her professional role. The teacher, by selecting AI tools and subordinating them to the pedagogical goal, becomes the chief architect who preserves the student's independent thinking, evidence-based approach, and moral responsibility. Therefore, the effective model of the future should not be "AI-centric education," but "teacher-led, AI-enriched education with human goals." A practical recommendation for Uzbekistan is that AI policy should be pursued in conjunction with the digital economy, scientific capacity, data sovereignty, and education reform, and risk-based regulation and professional development in all priority areas should be carried out simultaneously. Only such an approach can transform artificial intelligence from a fad into a policy, and from policy into a social benefit. Several directions remain open for future research: first, empirical observations and surveys on the use of AI in Uzbek universities and schools; second, assessing teachers' AI competencies based on national criteria; third, experimentally testing the quality, bias, and pedagogical utility of generative models in the Uzbek language; fourth, developing methodological standards for AI audits in public services and the private sector. This article serves as a theoretical and political-methodological foundation for this future research. In general, the main choice regarding artificial intelligence is not whether to accept or reject the technology, but under what social conditions to introduce it. In this competition, direction is more important than speed, purpose is more important than power, and human control is more important than automation. If this priority is maintained, AI can become a tool for economic growth, scientific innovation, and educational quality for Uzbekistan; otherwise, it will become a factor that multiplies old problems in a new form.

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