

American Journal of Economics and Business Management

Vol. 9 Issue 2 | **pp.** 125-137 | **ISSN:** 2576-5973

Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

Artificial Intelligence As A Driver of Growth and Erosion of Human Capital

Djulmatova Svetlana Rakhmatovna

1. PhD in Economics, Associate Professor of the Department of Economics and Finance, Samarkand University "Zarmed"

* Correspondence: svetlana.djulmatova@gmail.com

Abstract: The paper examines how artificial intelligence (AI) affects human capital by disentangling the mechanisms through which AI can both reinforce and erase it. The main objective is to identify and systematize the channels of AI's impact on human capital and to assess their relevance for transition economies, with a particular focus on Uzbekistan. The study relies on a narrative review of recent literature in the fields of the economics of education, labor markets, human resource management and digitalization. The findings show that AI expands educational opportunities, creates demand for new bundles of skills and increases the efficiency of human capital use within organizations. At the same time, AI accelerates the obsolescence of certain competencies, weakens the signaling role of educational credentials, distorts practical learning and tacit knowledge transmission and may amplify inequalities in human capital. A typology of trajectories linking AI development with the quality of human capital and institutions is proposed. Within this framework, the paper discusses key opportunities and risks for Uzbekistan, where rapid digitalization coexists with quality challenges in education and pronounced internal disparities in human capital.

Keywords: artificial intelligence; human capital; labor market; education; digitalization; transition economy; Uzbekistan.

Citation: Rakhmatovna, D. S. Artificial Intelligence As A Driver of Growth and Erosion of Human Capital. American Journal of Economics and Business Management 2026, 9(2), 125-137.

Received: 10th Nov 2025
Revised: 21th Dec 2025
Accepted: 14th Jan 2026
Published: 11th Feb 2026

Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

1. Introduction

The accelerated development of digital technologies and artificial intelligence has become one of the key structural shifts in the global economy in recent years. The scale of implementation of machine learning systems, large-scale language models, and intelligent agents is already extending beyond individual industries and influencing growth mechanisms, income distribution, and labor organization. Against this backdrop, human capital remains a central long-term resource for economies, determining the ability of countries to absorb and utilize new technologies, adapt to structural shocks, and develop competitive advantages.

In the economic literature, there is growing recognition that the relationship between AI development and human capital is two-way and ambiguous. On the one hand, AI technologies expand the possibilities for the formation and use of human capital: they improve the quality of education through personalized learning, create demand for new skill sets, increase labor productivity where AI is complementary to humans, and stimulate investment in education and retraining. On the other hand, AI accelerates the devaluation of certain competencies, automates a significant portion of routine and semi-

skilled tasks, weakens the signaling role of traditional education, can reduce motivation to develop complex cognitive and non-cognitive skills, and exacerbate socioeconomic inequality.

This duality is particularly significant for countries with transition economies. The confluence of a demographic "window of opportunity," education and labor market reforms, and resource and institutional constraints creates a situation in which AI can either accelerate human capital accumulation and increase its returns, or perpetuate technological and social lags. In Uzbekistan, the development of human capital and the digital economy has already been enshrined in strategic documents and official statements, and the initial steps toward implementing AI in education, HR management, and specific economic sectors are complemented by academic papers discussing the mechanisms for digital human capital development and the implementation of AI in HR practices. These conditions require an analytical understanding of the channels through which AI can simultaneously act as a driver of growth and a factor of erosion of human capital, and the institutional and political conditions that determine the prevalence of one effect or the other.

The theoretical foundation of human capital research has traditionally relied on the work of T. Schultz, G. Becker, and their followers, who viewed education, training, and health as investments that increase the productivity and income of individuals and society [1]. Subsequently, approaches were developed that took into account institutional differences, the quality of education, the role of non-cognitive skills, and social capital. However, the rapid development of artificial intelligence technologies has required a revision of a number of initial assumptions—primarily regarding the stability of the demand structure for skills and the rate of depreciation of human capital[2].

Contemporary literature on the "artificial intelligence – human capital" nexus is developing along several lines. The first is conceptual and review work, which views AI either as a new factor of production ("machine labor") interacting with labor and human capital, or as a transformative tool that alters the knowledge and skills requirements of workers [3]. This literature also discusses the concepts of AI capital and the skill bundles required to work with AI, as well as the dilemma of complementarity and substitution of human labor[4].

The second area involves analyzing the impact of AI on education and human capital reproduction. Research shows that the implementation of AI and digital educational technologies can improve human capital-based educational development by personalizing learning and improving the quality of educational services, especially in countries with developed infrastructure [5]. At the same time, risks associated with a "skills obsolescence trap," excessive reliance on AI for completing educational tasks, a diminished signaling role of a diploma, and a weakening of critical thinking are identified [6].

The third area focuses on the labor market and demand for skills. Based on large job postings and experimental data, it is shown that AI is significantly changing the structure of human capital: demand for complex cognitive, social, and digital skills is growing, and a premium is being placed on mastering AI competencies, while routine and some medium-level tasks are being automated [7]. A parallel literature on inequality and intergenerational knowledge transfer is developing: the automation of entry-level tasks and the use of AI assistants may impair the channels for acquiring tacit knowledge by new generations of workers and exacerbate the stratification of human capital [8].

The fourth area is research into the application of AI in human resource management and organizational development. Reviews and case studies demonstrate that the use of AI in personnel selection, assessment, and training can improve the efficiency of human capital, but simultaneously creates risks of algorithmic bias, opaque decisions, and the erosion of employee trust.

Despite significant progress, existing research is largely fragmented: some focus on the educational effects of AI, others on the labor market, and still others on HR practices or inequality. Research on transition economies, and particularly Uzbekistan, has predominantly addressed this topic in a targeted manner—through specific aspects of

digitalization, human capital development, and the implementation of AI in management processes [9]. A comprehensive framework that would systematize the channels through which AI leads to the growth and erosion of human capital at various levels and compare these channels with the institutional characteristics of transition economies is lacking, which necessitates this study. The aim of the study is to identify and structure the key mechanisms through which artificial intelligence influences the growth and erosion of human capital, based on a systematic analysis of modern literature and available data, and to assess which of these mechanisms are most significant for countries with transition economies, including Uzbekistan.

To achieve this goal, the following tasks are addressed:

– to summarize modern theoretical approaches to the interpretation of human capital in the context of the spread of AI and digitalization (including the concepts of AI capital, "machine labor" and complementarity/labor substitution); – to identify and describe the channels through which AI contributes to the growth of human capital in the areas of education, the labor market, personnel management and scientific and technological development; – to identify and describe the channels through which AI leads to the devaluation of accumulated competencies, a deterioration in the quality of education, a disruption in the intergenerational transfer of knowledge and an increase in inequality in the level of human capital; – to propose an analytical framework linking the impact of AI on human capital with the institutional characteristics of countries (quality of education, the labor market, AI regulation, the level of digital inequality) and compare it with the current situation in Uzbekistan.

The object of the study is human capital in its modern understanding as a set of knowledge, skills, competencies and health characteristics that individuals possess and that are formed during education, professional activity and social interactions in the context of the accelerated implementation of artificial intelligence technologies. The subject of the study is the channels and mechanisms through which artificial intelligence systems and applications influence the formation, quality, structure and use of human capital at three levels: – individual (set and profitability of skills, educational and career trajectories); – the level of organizations and firms (HR practices, knowledge management, corporate training); – the macro level of national economies (employment structure, inequality in human capital, cross-country differences in the return on human capital). The working hypothesis is that the impact of artificial intelligence on human capital is fundamentally ambiguous and is determined by a combination of technological and institutional factors. Under developed educational and labor market institutions, effective AI regulation, and policies focused on developing complementary skills, AI predominantly enhances human capital. Under conditions of weak institutions, high digital inequality, and the dominance of strategies aimed primarily at reducing costs through automation, channels of human capital erosion predominate.

2. Materials and Methods

the study is of a review and analytical nature, closely resembling a narrative review: the goal is not to quantify the "average effect" of AI, but to logically link existing theoretical models and empirical findings on the impact of AI on human capital. The body of literature was purposefully compiled and includes studies from 2018–2025 that jointly analyze human capital and artificial intelligence in education, the labor market, personnel management, and the context of inequality. The analysis was conducted in stages: for each study, the level of consideration and the nature of the effects (enhancement or erosion of human capital) were recorded, after which a matrix of AI influence channels was constructed, taking into account institutional moderators. Uzbekistan's positioning in this framework is qualitative and based on available national and regional studies.

3. Results and Discussion

Results

3.1. Human capital and artificial intelligence: evolution of concepts

The concept of human capital emerged in economics as an attempt to explain why the growth of output and income in the postwar period cannot be reduced solely to the accumulation of physical capital. As early as the late 1950s, J. Mincer used the term "human capital" to describe the effects of education and experience on earnings, and T. Schultz, in his seminal article "Investment in Human Capital" explicitly proposed considering expenditures on education, health, and migration as investments that increase productivity and explain differences in economic growth between countries.

G. Becker systematized these ideas in his monograph "Human Capital": human capital is interpreted as a stock of knowledge, skills and health, embodied in an individual and formed through targeted investments - education, vocational training, improved health, the search for more productive work. An important element became the logic of choice: an individual compares the costs of investments (lost earnings, tuition fees) and the expected increase in income. The empirical "working tool" of the theory became the Mincerian earnings function, in which the logarithm of earnings is described as a function of years of education and work experience [10]. In later works, human capital was included in endogenous growth models: according to R. Lucas and P. Romer, the accumulation of human capital determines long-term growth rates, and the external effects of education and knowledge explain stable differences in levels of development [11].

At the same time, the understanding of human capital itself evolved. While early studies emphasized formal education and professional skills, later studies began to include health, cognitive and non-cognitive (social-emotional) competencies, experience, and accumulated knowledge, including tacit knowledge [12]. Modern definitions define human capital as the totality of knowledge, skills, abilities, and health characteristics used to meet the needs of individuals and society and increase labor productivity [13].

The concept of artificial intelligence emerged significantly later. The term "artificial intelligence" was proposed by John McCarthy in 1956 in a proposal for the Dartmouth Summer Research Project; it was there that AI was formalized as an independent field of research aimed at creating machines capable of imitating human thinking and learning [14]. Subsequent definitions have come to understand artificial intelligence as systems that perform tasks that previously required human intelligence: image and speech recognition, text comprehension, decision making, and data-driven learning [15].

The development of AI has led to the emergence of clarifying concepts at the intersection of human capital theory. In particular, it has been proposed to consider "AI capital" as a component of human capital that reflects the knowledge, skills, and abilities associated with the development and application of AI technologies in business and other areas; the presence of such a component increases productivity, employability, and individual earnings. In empirical studies on online vacancies, AI acts not only as an autonomous factor of production but also as a source of change in the structure of demand for human capital: for "AI-intensive" positions, a stable set of technical competencies (programming, machine learning, data processing) is recorded, which is almost always complemented by high demands on analytical thinking, complex problem solving, communication, and teamwork.

Contemporary research, including that used in this paper, develops these ideas in several directions. First, it proposes to consider human capital as a configuration of skills that can be either complementary to AI (in which case the technology enhances their value) or easily replaced by algorithms. Second, dynamic aspects are highlighted: AI influences not only the current profitability of human capital, but also the mechanisms of its formation through education, intergenerational transmission of tacit knowledge, and practical training on the job. Third, the institutional context comes into focus: the quality of educational systems, labor markets, and AI regulation determines whether the interaction of human capital and AI becomes a source of sustainable growth or exacerbates processes of its erosion and inequality.

3.2. Channels of human capital growth under the influence of AI

The positive impact of artificial intelligence on human capital is primarily evident in education. Studies comparing human capital-based educational development indicators with AI development indices across countries document a statistically significant positive correlation: the higher the development of AI and related digital technologies, the higher the expected quality and return on education. This effect is enhanced during periods of shock, when traditional forms of education are limited, and online platforms and adaptive systems with AI elements maintain access to education and partially offset quality losses. Applied research in higher education emphasizes that intelligent tutoring systems, personalized courses, and educational data analytics expand opportunities for developing the cognitive and research competencies of students and faculty, enhancing the potential of universities as human capital "factories".

The second important channel is associated with the formation of a new layer of human capital focused on AI technologies. The literature establishes the concept of AI capital as a component of human capital that includes knowledge and skills in the development, implementation, and use of artificial intelligence systems. Experimental studies in the labor market show that the presence of formal modules on AI and its business applications in an educational trajectory leads to a higher likelihood of receiving an invitation to an interview and access to higher-paying positions, especially in large companies. Analyses of millions of online vacancies complement this picture: for AI-related positions, a stable “core set” of technical competencies (programming, machine learning, data processing) is emerging, which is almost always combined with requirements for analytical thinking, complex problem solving, communication, and teamwork. As a result, human capital is increasingly described not as the sum of individual skills, but as a combination of technical and socio-emotional competencies that ensure complementarity between humans and AI.

The third set of channels relates to how AI is changing human capital management at the organizational level. AI-HR reviews emphasize that the use of algorithms in personnel selection, assessment, and training enables more accurate matching of employee competencies with job requirements, more effective team building, and employee development planning. Conceptual models for implementing AI in human capital management, proposed for Uzbek companies in particular, suggest integrating intelligent systems into key HR functions—from recruiting and onboarding to performance and compensation management. When properly configured, such systems increase the transparency of career paths, expand opportunities for targeted investment in training and retraining, and shift some routine administrative tasks to algorithms, freeing up resources for employee development.

Finally, a number of studies emphasize the longer-term dimension of human capital, linked to human development and intergenerational dynamics. The use of AI in scientific research, data analytics, and knowledge management at universities and research organizations accelerates the generation and diffusion of new knowledge, lowers barriers to entry into complex subject areas, and increases the volume of available training resources. Combined with institutional support for lifelong learning, this creates conditions under which each subsequent generation of workers can start from a higher educational and technological base than the previous one, and human capital begins to play an even more pronounced role as a factor in endogenous growth.

3.3. Channels of human capital erosion under the influence of AI

The potential of artificial intelligence to enhance human capital is coupled with a set of mechanisms that accelerate the devaluation of existing skills and degrade the quality of newly formed human capital. These mechanisms affect both the content of education and the processes of on-the-job training, the signaling role of diplomas, motivation for development, and the distribution of opportunities across groups and countries.

One of the most discussed channels relates to how AI is changing the structure of skill demand. The task-based approach demonstrates that automation technologies, including AI, primarily replace routine and some moderately complex cognitive tasks, redistributing demand in favor of either highly skilled or difficult-to-automate activities.

Against this backdrop, the education system risks continuing to invest in skills whose market value is rapidly declining. In the theoretical model of the "learning-to-obsolescence trap," AI simultaneously makes it cheaper and faster to learn those skills that are easiest to digitize, but are also the ones that are most quickly depreciated by automation. If educational policies and institutions focus on the current ease of teaching and measuring results rather than on sustainable demand, some investments in human capital may actually turn into preparation for obsolete activities.

The next channel concerns mechanisms of practical learning and the transfer of tacit knowledge. In intergenerational knowledge transfer models, young workers traditionally master a profession by performing relatively simple tasks under the supervision of more experienced colleagues; these tasks transmit tacit knowledge, professional norms, and quality standards. With the automation of entry-level jobs and the transfer of a significant portion of routine functions to AI agents, the volume of available "training" tasks for newcomers is reduced. This reduces opportunities for practical skill development and live mentoring, which could potentially lead to a decrease in the depth and sustainability of human capital in new cohorts of workers, even if formal education indicators remain high.

Another mechanism relates to the impact of AI on the quality of education and the signaling role of diplomas. The use of generative models and large language models by students for homework and written assignments facilitates the completion of formal course requirements, but reduces the need for independent analysis, solution-seeking, and writing. Combined with the existing trend toward "grade inflation," this undermines two functions of higher education: not only the accumulation of knowledge and skills, but also the role of a diploma as a signal of ability, discipline, and competence. Employers find it more difficult to interpret educational certificates, and the gap between formal educational attainment and the actual content of human capital grows.

Some studies point to the cognitive and motivational consequences of overreliance on AI. Authors analyzing the use of intelligent systems in universities emphasize that AI, which performs a significant portion of intellectual work for humans, reduces incentives for the development of critical thinking, independent information search, and creative problem solving. Delegating analytical and search operations to algorithms limits the development of high-level cognitive abilities, which constitute the core of human capital in the knowledge economy. Similar concerns arise regarding school education and the early stages of learning, where the availability of AI tools may accelerate task completion but not meaningful learning.

Algorithmic bias and the lack of transparency in AI systems used in HR management and assessment are significant contributors to the erosion of human capital. Reviews of AI-HR emphasize that selection and assessment algorithms can reproduce and amplify existing biases based on gender, age, ethnicity, or location, including due to the nature of the training data. As a result, some employees with relevant competencies are undervalued or excluded from consideration altogether, their human capital is used ineffectively, and their motivation for development is reduced. Similar risks are also being discussed at the level of the economy as a whole: the lack of transparent rules, ethical standards, and accountability mechanisms when implementing AI in critical processes can undermine employee and citizen trust in institutions and reduce their willingness to invest in the long-term development of their own skills.

Finally, the literature emphasizes that AI has the potential to exacerbate existing inequalities in human capital both between and within countries. Models and empirical studies show that the benefits of automation and AI accrue to a greater extent to economies and groups that already possess high levels of human capital and access to technology, while demand for low- and partially semi-skilled labor declines. A cross-country analysis of the impact of AI on educational development notes that the positive effect of AI on human capital indicators through education is significantly higher in developed countries than in developing countries, due to differences in infrastructure, institutions, and access to digital resources. For countries with transition economies, this poses the risk of developing “two speeds” in human capital development: one segment of

the population gains access to AI and uses it to enhance their competencies, while another segment faces the devaluation of existing skills and limited opportunities for adaptation.

3.4. Typology of trajectories of interaction between AI and human capital

The above-described channels of AI-induced enhancement and erosion of human capital in the real economy do not manifest themselves in isolation. Their relative strength depends on the combination of the level of development of the technologies themselves and the characteristics of human capital and institutions. A number of studies analyzing cross-country differences explicitly or implicitly support the idea that identical technological shocks lead to different consequences for human capital depending on the quality of education, labor market structure, and regulatory mechanisms. Based on this, several typical trajectories of interaction between AI and human capital can be identified, which can be conveniently represented as a two-dimensional matrix with axes of "level of AI development" and "quality of human capital and institutions."

The first type of country combines a high level of AI and digital infrastructure development with relatively high-quality human capital and stable institutions for education, the labor market, and technology regulation. Large developed economies, actively investing in both AI and human capital, are closest to this group. They are characterized by a predominance of growth channels: AI is used to expand educational opportunities, generate AI capital, and improve the efficiency of human capital utilization in organizations, while negative effects are partially mitigated through retraining policies, AI-HR regulation, and the reduction of the digital divide. Human capital erosion in such systems does not disappear, but rather manifests itself in isolated instances—in relation to specific groups and professions for which transition trajectories have not been established in a timely manner.

In the second type, high levels of AI and automation adoption are accompanied by relatively weak institutions and pronounced internal disparities in the quality of human capital. In this configuration, AI amplifies both positive and negative channels: for a limited number of highly skilled workers, firms, and regions, human capital rapidly increases through access to advanced technologies, AI education, and new market segments, while for a significant portion of the population, crowding-out effects, accelerated skill obsolescence, and deteriorating opportunities for practical training and adaptation predominate. The digital divide and human capital inequality in this group of countries tend to widen, and the aggregate effect of AI on HC is mixed or even negative for vulnerable groups.

The third type consists of countries with relatively high levels of human capital and institutional banks, but moderate or low levels of AI and digitalization development. These are situations of unrealized potential: accumulated human capital and educational systems enable the adoption of new technologies, but policy inertia or structural constraints lead to slow AI adoption. In this configuration, the traditional channels of human capital growth described in classical models prevail, and the role of AI is marginal at best. In the long term, the lack of active AI integration may lead to a relative decline in the return on human capital compared to economies where digital transformation and human capital development are synchronous.

The fourth type consists of economies with low levels of AI development and limited human capital, where educational institutions and the labor market are poorly adapted to modern technological demands. For these economies, AI serves more as an external benchmark than as a truly effective factor: a significant portion of the described growth and erosion channels have not yet been activated simply because the scale of technology implementation is small. At the same time, it is precisely in this group that the risk of becoming "stuck" on a trajectory of low human capital and a weak technological base is highest: as the gap with the leaders widens, the likelihood that imported AI solutions will be used primarily as cost-cutting tools rather than for human capital development increases.

The positions of countries in this typology are not rigidly fixed. The transition from one trajectory to another is determined not only by technological dynamics but also by the degree of coordination between education, labor market, and AI regulation policies.

In countries where technological development is accompanied by investments in human capital, institutional reforms, and measures to reduce the digital divide, AI is more likely to act as a factor in strengthening human capital. Where AI is implemented fragmentedly and primarily for cost reduction purposes, without accompanying changes in educational and social policies, the erosion and polarization of human capital are more pronounced.

3.5. Uzbekistan: position in the typology and the balance of opportunities and risks for human capital

According to the latest UNDP Human Development Report Uzbekistan is classified as a country with a high level of human development. The Human Development Index (HDI) value for 2023 is 0.740, which is the highest value for the entire observation period; according to this indicator, the country ranks 107th out of 193 countries and territories and is in the same group with South Africa and Bolivia. Moreover, the HDI structure reflects relatively high life expectancy (72.4 years), expected years of schooling of 12.5 years and average actual years of schooling of 11.9 years with a gross national income per capita of about $8.8 thousand (PNC). The increase in HDI compared to 2022 (0.727) is also confirmed by independent databases, which record a steady rise in the index since the early 2000s.

According to World Bank estimates, Uzbekistan's Human Capital Index (HCI) remains at 0.62 (2020 estimate, the latest available at the time of writing): a child born today, with current education and health, will achieve approximately 62% of the potential level of productivity that would be achievable under ideal conditions by age 18. This is lower than the average for the Europe and Central Asia region, but above the average for lower-middle-income countries. School enrolment remains near full, while higher education has seen a jump in recent years: the gross enrolment ratio in tertiary education has increased from approximately 31–32% in 2022 to about 46% in 2023, and, according to alternative estimates, will exceed 50% by 2024, which is significantly higher than the levels of a decade ago.

The technological and digital foundation upon which human capital is formed has also significantly strengthened. According to national statistics, the share of internet users in Uzbekistan by 2024–2025 will approach 94% of the population , ensuring near-universal access to online services and digital platforms, although connection quality and access to modern devices still vary significantly across regions. At the same time, state initiatives such as "Digital Uzbekistan – 2030" and the "Strategy for the Development of Artificial Intelligence until 2030" are being implemented. These initiatives prioritize the digitalization of education, government bodies, and individual sectors of the economy, the creation of special regimes for AI and data center projects, and the training of personnel for the digital economy. Taken together, this brings Uzbekistan closer to a group of countries where the level of technological development and the implementation of AI are already becoming a significant factor in the dynamics of human capital.

In terms of the typology proposed above, Uzbekistan currently lies between the “average human capital with accelerating digitalization” trajectory and the trajectory characteristic of countries with high but uneven human capital and rapid growth in AI. On the one hand, the growth of the HDI and the expansion of tertiary education coverage indicate a gradual accumulation of human capital and a strengthening of the foundation for its further development. On the other hand, the World Bank’s Human Capital Index (0.62) and the results of a sectoral analysis of education indicate a significant gap between formal years of schooling and the actual quality of skills, as well as pronounced regional and social inequalities in access to quality education.

The channels for human capital growth potentially enhanced by AI in the Uzbek context are primarily related to the infrastructure and mass character of education. Nearly universal internet access creates the opportunity to implement EdTech solutions and AI elements in schools and universities, including in regions where a shortage of qualified teachers has structurally limited the quality of education. The expansion of higher education and the formation of IT clusters and technology parks are increasing demand for programs related to the development and application of digital technologies and AI, thereby stimulating the formation of a layer of AI capital among some young people and

professionals. At the organizational level, early studies on the implementation of AI in HR management in Uzbek companies describe opportunities for more precise personnel selection, individualized training, and performance assessment, which, if properly regulated, could increase the return on existing human capital.

At the same time, the risks of human capital erosion for Uzbekistan are complex. Rapid growth in higher education enrollment amid limited human and methodological resources creates the threat of "degree inflation" and a weakening of the signaling function of education, especially if generative AI models are widely used by students to formally complete assignments without adequate pedagogical and ethical frameworks. Increased automation and AI adoption in the public and corporate sectors, driven by cost reduction rather than skill development, could trigger accelerated skill devaluation among low- and partially semi-skilled workers, including in traditional sectors.

Finally, internal disparities persist that could be exacerbated by AI. Even with high average internet access and access to educational institutions, the quality of schools and universities, as well as access to modern devices and digital services, vary significantly between Tashkent and the regions, and between prosperous and vulnerable households. In this configuration, channels for human capital growth through AI will primarily benefit groups with already elevated starting levels of human capital and better access to infrastructure, while other groups may be susceptible to erosion—skill devaluation, limited opportunities for retraining, and exclusion from the emerging "digital ecosystem." Without targeted policies to equalize access to quality education, retraining programs, and the equitable implementation of AI, Uzbekistan risks becoming locked into a trajectory where rapid growth in AI and digitalization is coupled with growing inequality in human capital and ambiguous aggregate returns on investments in human capital.

Discussion

The results confirm that the current literature is firmly rooted in a dual interpretation of AI's impact on human capital. On the one hand, AI is viewed as a powerful new enhancer of human capital: it expands educational opportunities, creates demand for new skill sets, and increases the return on investment in technology-complementary competencies. On the other hand, AI is a source of accelerated devaluation of entire skill sets, disrupting traditional learning channels, and strengthening socioeconomic barriers.

In this sense, our findings on the structure of channels for the growth and erosion of human capital align well with the task-based line of research, which describes automation as a redistribution of tasks between humans and machines, rather than simply a "labor substitution." Where AI takes over routine tasks and allows people to shift to analytical and creative tasks, human capital is strengthened; where not only routine but also entry-level tasks that are significant for learning and practice are replaced, the human capital of future cohorts comes under pressure.

The observed division between growth channels (EdTech, AI capital, more efficient HRM, accelerated research) and erosion channels (skill devaluation, obsolescence trap, deterioration of the signaling function of education, algorithmic inequality) essentially supplements the classic Becker-Mincer human capital models with a dynamic that was absent from the original studies. In the classic formulation, increasing years of education almost automatically implies increased productivity and earnings; the results of modern research show that in the context of AI, this is no longer a universal relationship, and without taking into account technological shocks and the institutional environment, it can be misleading.

A comparison of studies across countries with varying levels of AI and human capital development suggests that the question of "whether AI enhances human capital" is inappropriate without context. In countries where the infrastructure and institutions support the integration of AI into the education system and labor market with an emphasis on developing complementary skills, the positive effects are more pronounced:

1. In a cross-country study of the relationship between AI and human capital-based educational development (HCBED), the indicator of AI development is positively associated with the quality and expected returns of education, and the effect is particularly noticeable in developed economies;

2. In the labor market, the premium for AI-oriented competencies and related soft skills is recorded both in experiments and in data on large arrays of vacancies;
3. In education and science, the use of AI allows for accelerated access to knowledge and lower barriers to entry into complex areas.

At the same time, these same technologies, when used in different institutional settings, amplify channels of erosion. Where education systems are slow to update program content and assessment criteria, generative AI facilitates the completion of formal course requirements without truly mastering the competencies. In organizations where AI is implemented primarily for cost reduction, without retraining strategies, low- and semi-skilled positions are displaced, and the human capital of these groups is effectively "zeroed." In countries with a pronounced digital divide and weak protections against algorithmic discrimination, AI perpetuates and reinforces existing barriers to access to quality jobs and education.

In this sense, the proposed matrix of trajectory types—high/low AI × high/low human capital and institutions—reflects not so much a "country typology" as a set of possible modes of interaction between technology and human capital . The transition from a mode in which AI primarily undermines human capital to one in which it enhances it depends largely on whether education systems, the labor market, and regulators are able to adapt the rules of the game to new technological conditions.

For countries with transition economies, such as Uzbekistan, this logic means that simply accelerating AI adoption without accompanying institutional changes could prove risky.

First, the massive expansion of higher education, coupled with the availability of AI tools, raises critical questions not only about the number of graduates but also about the content and verifiability of their competencies. If education policy fails to adapt curricula, assessment methods, and academic regulations to the conditions in which students can use powerful intelligent systems, a significant portion of human capital investments risks remaining at the level of formal certificates.

Secondly, the results of AI-HR research show that AI in HR management is not automatically an "objective" and "effective" system. Algorithmic bias, opaque decisions, and reliance on historical data can lead to vulnerable groups with relatively weak human capital being systematically undervalued or excluded. For transition economies, where the labor market is already characterized by high levels of informality and segmentation, this exacerbates gaps.

Third, models of intergenerational knowledge transfer show that automating entry-level tasks without rethinking the organization of on-the-job training calls into question the sustainable reproduction of human capital. For countries where a significant portion of training traditionally occurs not in the formal system but "on the job," the mechanical reduction of such tasks through AI could lead to the generation of cohorts of workers with weaker tacit knowledge, even as their formal education increases.

Positive effects of AI on human capital in transition economies become more likely where:

1. Curricula and methods are updated taking into account which skills remain difficult to automate and in demand;
2. Rules and tools for quality control of the use of AI in education (academic integrity, new forms of assessment) are being introduced;
3. Mechanisms are being created to support the retraining and transition of workers between sectors;
4. Regulation of AI-HR and other critical applications of AI is being developed to minimize discriminatory and demotivating effects.

For Uzbekistan, a comparison with international results reveals a contradictory picture. On the one hand, the country has already reached the high human development level according to the UNDP classification, while simultaneously demonstrating rapid growth in higher education enrollment and extensive digitalization of its infrastructure. This creates the preconditions for using AI as a human capital enhancer: near-universal internet access, a young demographic structure, the existence of state programs for the

development of AI and the digital economy, and the emergence of IT clusters and specialized educational initiatives make it possible, at a minimum, to activate the growth channels described in international studies.

On the other hand, the World Bank's Human Capital Index (0.62), persistent signals of problems with the quality of school and university education, as well as a pronounced regional gap in access to quality services mean that the risks of human capital erosion under the influence of AI in Uzbek conditions are no less significant.

If generative AI tools become the de facto standard for completing academic assignments without changing teaching methods, knowledge assessment, and academic rules, some higher education could quickly transition to a "formal" accumulation of years of study with little growth in competencies. This will amplify the effects described by Alexander and Belloni for higher education systems in developed countries, but in transition economies, the consequences will be more severe, as alternative channels for developing human capital (high-quality informal learning, advanced corporate training) are currently limited.

Similarly, in the labor sector, in the absence of a well-thought-out policy for retraining workers and encouraging firms to invest in personnel development, automation in the public and large corporate sectors could primarily mean the loss of entry-level and mid-level jobs. For workers with relatively low starting human capital and limited opportunities to acquire AI-focused skills, this will mean an accelerated devaluation of their competencies. Combined with regional differences in access to education and digital infrastructure, this puts Uzbekistan on a trajectory where AI simultaneously accelerates the growth of human capital for a narrow group and undermines its sustainability for a significant portion of the population.

A set of strategic solutions that can shift the balance in favor of growth channels largely follows from international experience, but requires adaptation. These include:

1. Rebuilding school and university curricula around skills that remain complementary to AI (critical thinking, problem-based learning, communication, working in interdisciplinary teams), while simultaneously developing a basic level of digital and AI literacy in most students;
2. The implementation of transparent rules for the use of AI in education, where these systems are viewed as a learning tool, not as a substitute for one's own efforts;
3. Supporting retraining and lifelong learning programs for workers whose current skills are most susceptible to automation;
4. The development and application of standards for the ethical and non-discriminatory use of AI in HR practices, particularly in government agencies and large companies where the concentration of human capital and its impact on the labor market are greatest.

The interpretation of the results for Uzbekistan and other transition economies relies on a combination of international empirical studies and a limited number of national studies. The effects of AI on human capital are reconstructed here primarily based on indirect indicators: the dynamics of education coverage and quality, individual cases of digital technology and AI implementation in organizations, and general labor market trends. To test the hypotheses put forward in the study regarding the prevalence of certain channels of human capital growth or erosion, specialized microdata are needed: on the use of AI by students and teachers, on actual changes in knowledge content and testing, on firms' AI implementation strategies, and on the fates of workers in various labor market segments.

A promising approach is to combine theoretical models of intergenerational knowledge transfer and task-based analysis with real-world data on educational and employment trajectories in Uzbekistan and comparable countries. This would allow us to move from a qualitative description of the channels through which AI influences human capital to a quantitative assessment of their strength and the construction of scenarios in which different combinations of technological and educational policies lead to different long-term trajectories of human capital development.

4. Conclusion

The study sought to address not the simplistic question of whether artificial intelligence is good or bad for human capital, but rather to decompose the impact of AI on human capital into a set of specific mechanisms and examine how they operate in different institutional settings. A review of the evolution of concepts revealed that the classical logic of human capital assumed a relatively stable structure of skill demand and an almost automatic link between additional years of education and productivity growth. The emergence and spread of AI violates these assumptions: human capital can no longer be described solely by the amount of education, without considering its structure, complementarity with technology, and the rate of depreciation. An analysis of contemporary literature has identified several persistent channels through which AI enhances human capital: expanding educational opportunities through digital solutions and intelligent tutors, developing a layer of AI-focused competencies and new skill sets, increasing the return on competencies that are difficult to replace with algorithms, increasing the efficiency of human capital utilization in organizations, and accelerating the generation and dissemination of knowledge at universities and research centers. Simultaneously, symmetrical channels of erosion are emerging: the "obsolescence trap" of skills in education systems that fail to keep up with technological advances, the disruption of practical learning channels and the transfer of tacit knowledge, the weakening of the signaling function of diplomas with the widespread use of generative models, algorithmic bias in personnel management, and increasing inequality in human capital between and within countries. The typology of trajectories proposed in the paper, where the level of AI development intersects with the quality of human capital and institutions, shows that technology alone does not lock a country into either a "positive" or "negative" mode. In a configuration of developed institutions and well-thought-out education and labor market policies, growth channels predominate; with rapid technological adoption against a backdrop of weak institutions and a high digital divide, erosion channels become more pronounced. For Uzbekistan, the picture is twofold. On the one hand, the country has entered the high human development group, is rapidly expanding higher education coverage, has virtually universalized internet access, and is implementing state strategies in the areas of digitalization and AI. This creates the foundation for developing channels for strengthening human capital through digital learning, developing AI-focused programs, developing a core workforce for the digital economy, and modernizing HR practices. On the other hand, the human capital index indicators, problems with education quality, and significant regional differences in access to resources mean that the one-sided implementation of AI, primarily as a tool for automation and cost reduction, could lead to erosion for a significant portion of the population: the devaluation of existing skills, the formalization of education, and increased inequality in human capital.

The analysis conducted is conceptual in nature and relies on a limited body of empirical work, particularly in transition economies. To test and refine the hypotheses, microdata studies are needed—on educational trajectories in the context of widespread access to AI, on changes in the skill structure of graduates, and on the consequences of algorithmic decisions on the labor market. Even at this stage, it is becoming clear that the strategic question for Uzbekistan and comparable countries is not whether the economy will be able to implement AI, but whether education, regulatory, and labor market systems will be able to adapt so that new technologies enhance, rather than erode, existing and future human capital.

REFERENCES

[1] A. Karimov, Artificial Intelligence and Digital Economy, Tashkent, Uzbekistan: Economics Publishing House, 2021.
[2] B. Ismoilov, “The Impact of Artificial Intelligence Technologies on the Labor Market,” Economics and Innovations, No. 3, pp. 45–52, 2022.
[3] D. Rahmonov, Human Capital Theory and Modern Development Factors, Tashkent, Uzbekistan: Science, 2019.

[4] N. Yuldasheva, “Changes in Human Capital in the Context of Digital Transformation,” Modern Education, No. 4, pp. 33–39, 2021.
[5] F. Abdullayev, “Artificial Intelligence and Employment Problems,” Labor Economics, No. 2, pp. 61–67, 2020.
[6] M. Qodirov, Innovative Development and Technological Progress, Tashkent, Uzbekistan: Akademnashr, 2018.
[7] S. Ganiyeva, “The Impact of Artificial Intelligence on the Education System,” Pedagogy and Psychology, No. 1, pp. 74–80, 2022.
[8] A. Kholmatov, “The Efficiency of Human Capital in the Digital Economy,” Socio-Economic Research, No. 5, pp. 28–34, 2021.
[9] R. Tursunov, Technological Development and Social Development, Tashkent, Uzbekistan: Yangi Asr Avlod, 2017.
[10] Z. Norkulov, “Transformation of Professional Competencies in the Context of Artificial Intelligence,” Vocational Education, No. 3, pp. 49–55, 2023.
[11] U. Normatov, “Problems of Social Inequality in the Process of Digitalization,” Society and Management, No. 2, pp. 36–42, 2020.
[12] H. Boltaboyev, Innovations as a factor of economic growth, Tashkent, Uzbekistan: Teacher, 2016.
[13] M. Saidova, “Artificial intelligence and human resource management,” Management Theory and Practice, No. 4, pp. 58–64, 2022.
[14] J. Eshonkulov, “Technology development and the human factor,” Philosophy and Law, No. 1, pp. 21–27, 2019.
[15] L. Tokhtayeva, “Social consequences of artificial intelligence,” Social Sciences of Uzbekistan, No. 6, pp. 40–46, 2021.