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THE CONTRIBUTION OF ARTIFICIAL INTELLIGENCE TO THE DEVELOPMENT OF AN INNOVATIVE CULTURE AND THE ENHANCEMENT OF HIGHER EDUCATION QUALITY

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Original research

A B S T R A C T

The research analyzes the impact of AI on innovative culture and the quality of higher education. The research is based on data from 14 countries in South and Central Asia (SCA) for 2024. Using comparative analysis, the authors demonstrate a high level of AI-driven economic development and quality higher education, along with an outstanding innovative culture in Uzbekistan in 2024, compared to the regional average in SCA countries. This establishes Uzbekistan's leadership in the region in terms of engagement with the Fifth Industrial Revolution. Through regression analysis, the authors developed an econometric model to measure the impact of AI-driven economic factors on the indicators of innovative culture and higher education quality in SCA countries. The theoretical contribution of this model lies in its ability to reveal causal relationships between the development of the AI economy and its potential to support the growth of innovative culture and improve higher education quality. The research identifies significant prospects for fostering an innovative culture and enhancing higher education quality in Uzbekistan based on AI-driven economic advancements, supported by the authors' forecast through 2028. This forecast can be a practical roadmap for advancing innovative culture and higher education quality in Uzbekistan through AI-driven economic development over the coming years. The main conclusion highlights the feasibility of transitioning to Industry 5.0 in Uzbekistan, provided that AI's role in advancing innovative culture and improving higher education quality is optimized through increased data accessibility and AI infrastructure development. This is to be achieved while maintaining the 2024 levels of e-government based on AI and the practical application of AI technologies.

1. INTRODUCTION

Artificial intelligence (AI) in the context of the Fifth Industrial Revolution has emerged as one of the key factors shaping the functioning and development of socio-economic systems. The challenge lies in the fact that the spread of AI is occurring spontaneously and rapidly. The lack of accumulated experience in the practical application of AI, coupled with insufficient scientific exploration of this experience, creates uncertainty regarding the societal and economic

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consequences of transitioning to Industry 5.0 for the knowledge society and the innovative economy.

By automating mechanical operations in production and distribution and influencing decision-making processes (e.g., purchasing, management, investment, and regulatory decisions), AI raises questions about the necessity of human intelligence, effectively replacing it. This poses a threat to social progress, fundamentally distinguishing the Fifth Industrial Revolution from its predecessor, the Fourth Industrial Revolution. The advent of the digital era sparked rapid development and active realization of human potential.

The establishment of Industry 4.0 required the accumulation of significant and exceptional human resources – digital talent capable of mastering advanced technologies and breakthrough innovations. The sharp increase in the human-resource intensity of economic processes contributed to integrating high human capital value and talent retention practices into business culture. Furthermore, during the Fourth Industrial Revolution, intensive development of an innovative culture and improvements in higher education quality were initiated. The drivers of innovative culture development included the necessity to protect intellectual property rights to gain and sustain digital competitive advantages, the growing preference and corresponding demand for innovative products, a surge in venture investments, and high and rising technological barriers in global markets.

The drivers of the improvement of higher education quality included stronger ties between universities and employers through the expansion of targeted corporate training programs, enhanced oversight of education quality due to the popularization of distance learning, and a shift in student values – from pursuing higher education merely for a diploma to embracing lifelong learning as a means to fill gaps in digital competencies.

Everything changed with the advent of the Fifth Industrial Revolution. At the core of the digital competitiveness of economic entities and systems in the emerging Industry 5.0 lies artificial intelligence (AI). However, its influence on socio-economic processes is contradictory. From the perspective of innovative culture, on the one hand, innovations in the automation of business operations driven by AI are welcomed because they enhance competitiveness and support the high-tech nature of production and distribution processes. On the other hand, AI becomes the primary source of innovation, undermining the research and development (R&D) activities of business structures and creating a risk of excluding humans from innovative activities in Industry 5.0.

From the perspective of higher education quality, on the one hand, to effectively perform labor functions in cyber-social systems, workers require deep knowledge and active skills in utilizing AI, which increases the importance of higher education for digital talent. On the other hand, a growing number of workers are displaced and re-trained for industries that are not subject to AI-driven automation, typically dominated by low-skilled jobs that do not require higher education. This undermines the value of higher education, as possessing a degree fails to guarantee a successful career or high wages and reduces employment opportunities in sectors where vacancies are primarily available for individuals without higher education.

Thus, the scientific exploration of this problem is highly relevant, considering that AI-based automation should serve humanity's interests by avoiding social degradation. Otherwise, the rationale for transitioning to Industry 5.0 becomes questionable and should be reconsidered. To address this issue, this research aims to determine the impact of AI on innovative culture and the quality of higher education.

2. LITERATURE REVIEW

The theoretical foundation of this research is the concept of the AI economy as an economic system in which socio-economic processes are deeply integrated with AI technologies, enabling widespread automation (Bansal et al., 2024; Ojha and Nikhil, 2024; Otarbayeva et al., 2024; Popkova et al., 2024; Pramanik et al., 2024; Sukhodolov et al., 2018).

The economic perspective presented in this research for analyzing the Fifth Industrial Revolution stems from the aim to account for the inseparable connection between social and economic transformations occurring during the technological modernization of the innovative economy and knowledge society, which can be considered the predecessors of the AI economy. This serves as an additional argument for using the term "AI economy" in this research because it most accurately reflects the scientific meaning of the technological shifts occurring in economic systems with the proliferation of AI-based smart technologies. A comprehensive literature review has identified the following three key characteristics of AI economy development:

- AI-based e-government as a system for providing online public services, automated governmental monitoring of the economy, and intelligent support for regulatory decision-making (Galoyan & Matevosyan, 2023; Kumar et al., 2024);
- Practical application of AI technologies in society and business to achieve smart automation in production and distribution processes (Corea, 2024; Mardonov et al., 2021);
- Data and AI economy infrastructure, encompassing related technologies such as big data and the Internet of Things (IoT) powered by 5G, which support the smart automation of economic processes (Morozova et al., 2018; Pachouri et al., 2023).

In the existing literature, two key manifestations of social progress are also highlighted. The first manifestation is the development of an innovative culture, which reflects the growing innovative activity within society and the economy. This includes the following:

- Collaborative partnerships between universities and industries in innovation, signifying the prevalence of innovation networks, the reliability of engineering support for university-driven innovations, and the broad opportunities for their commercialization (Andekina et al., 2024);
- The intensity of introducing innovative products to the market, demonstrating the engagement of enterprises in the innovative economy (Mkrtchyan et al., 2023);
- The status of research institutions, reflecting their authority and the robustness of institutional support for the innovative economy (Abdurakhmanova et al., 2024; Bogoviz et al., 2020);
- The scale of activity of innovative companies, indicating the prevalence of high-tech startups, the production capacity of innovative firms, and the extent of its utilization (Yuldashev et al., 2021).

The second manifestation is enhancing higher education quality, which fosters the development and realization of human potential while increasing the competency levels of highly skilled and digitally proficient professionals. This includes the following:

- Employment opportunities for individuals with higher education, reflecting the balance between the development of the higher education market and the labor market (Abdurakhmanov et al., 2019; Maxyutova et al., 2022);
- Labor productivity, which, in the context of the AI economy, is determined by the level of education of the workforce and the degree of automation in their workplaces (Kaliyeva et al., 2022).

The literature review revealed that, although the theoretical aspects of the AI economy are thoroughly addressed, insufficient attention has been paid to the practical implications of the Fifth Industrial Revolution in existing publications, creating a gap in the research. The research question is: "What are the consequences of AI economy development for innovative culture and the quality of higher education?"

To address this question, the research employs econometric modeling to explore the causal relationships between AI economy development and its potential to support the growth of innovative culture and improve higher education quality. It also seeks to develop recommendations for unlocking this potential. To ensure the practical relevance of the research's scientific and methodological framework, the authors used the example of Uzbekistan, where the development of the AI economy has been partially covered in several publications, including by Abdurashidova and Balbaa (2023), Eshov et al. (2023), Kobilov et al. (2023), Shakib Kotamjani et al. (2023).

3. MATERIALS AND METHODS

3.1. Research Sample

The set of variables in this research includes, first, the following indicators characterizing the development of the AI economy based on statistics from Oxford Insights (2024):

- "Government" (E_{AI1}) as an indicator of the level of development of AI-based e-government;
- "Technology" (E_{AI2}) as an indicator of the activity in the applied use of AI technologies;
- "Data & Infrastructure" (E_{AI3}) as an indicator of the accessibility of data and infrastructure within the AI economy.

Table 1. The AI economy, innovation culture, and quality of higher education in SCA in 2024, points 1–100

Country	Innovative culture				Quality of higher education		AI economy		
	Prevalence of university-industry partnerships	Intensity of bringing innovative products to the market	Status of research institutions	Scale of activities of innovative companies	Employment opportunities for personnel with higher education	Labor productivity	Level of development of AI-based e-government	Activity of applied use of AI technologies	Availability of data and infrastructure of the AI economy
	ICD_1	ICD_2	ICD_3	ICD_4	HEQ_1	HEQ_2	E_{AI1}	E_{AI2}	E_{AI3}
Armenia	35.8	45.7	44.3	52.3	64.5	13.6	43.50	33.58	58.57
Azerbaijan	59.8	29.5	44.8	64.7	83.5	12.1	55.86	30.77	57.82
Bangladesh	33.2	0.0	58.1	45.5	64.3	5.6	57.96	26.07	54.10
Bhutan	36.6	57.3	0.0	45.9	60.0	9.5	36.81	24.31	49.52
Georgia	54.9	55.6	41.1	58.4	58.9	15.0	41.96	30.33	51.50
India	42.3	7.5	75.2	43.7	47.1	7.8	75.18	49.39	63.17
Kazakhstan	34.8	24.1	50.0	40.5	93.6	22.7	48.56	30.97	66.13
Kyrgyzstan	32.3	58.3	28.6	41.0	80.7	5.0	33.53	22.86	45.90
Nepal	39.4	65.4	45.8	42.6	72.5	5.8	31.04	24.21	37.06
Pakistan	51.5	4.2	62.9	54.1	45.8	6.5	43.00	34.07	49.53
Sri Lanka	47.5	0.0	48.0	46.4	74.8	12.9	42.05	33.02	50.60
Tajikistan	38.3	23.9	0.0	44.9	78.3	6.3	53.18	20.41	42.77
Turkey	42.2	8.47	66.7	48.0	62.4	37.1	75.08	42.32	64.13
Uzbekistan	56.0	29.9	54.2	57.8	95.8	8.6	49.07	24.80	57.49

Source: Developed by the authors based on the materials from "Knowledge for All" (Dutta et al., 2024) and Oxford Insights (2024). According to Table 1, the research sample consists of 14 countries.

Second, the research includes the following indicators of innovative culture development based on statistics from "Knowledge for All" (Dutta et al., 2024):

- "University-industry collaboration in R&D" (ICD_1) as an indicator of collaborative partnerships between universities and industries;

- "Firms producing new products and services (%)" (ICD_2) as an indicator of the intensity of introducing innovative products to the market;
- "Research institutions prominence" (ICD_3) as an indicator of the status and prominence of research institutions;
- "Growth of innovative companies" (ICD_4) as an indicator of the scale of activities of innovative companies.

Third, the research includes the following indicators of higher education quality based on statistics from "Knowledge for All" (Dutta et al., 2024):

- "Unemployment rate with advanced education" (HEQ_1) as an indicator of employment opportunities for individuals with higher education;
- "Output per worker" (HEQ_2) as an indicator of labor productivity.

The research sample (Table 1) includes countries from South and Central Asia (SCA) that belong to this geographic region as defined by Oxford Insights (2024), for which statistical data is also available in "Knowledge for All" (Dutta et al., 2024). The considered period is 2024. For accurate interpretation of the results, all indicators are measured using a unified metric expressed in points.

3.2. Research Methodology and Procedure

The logic of this research involves the sequential resolution of three research objectives. The first objective is to determine the level of development of the AI economy, innovative culture, and education quality in Uzbekistan in 2024. To achieve this, the authors compared the values of the indicators for Uzbekistan to the arithmetic averages for the SCA region, with the ratio of these indicators expressed as percentages.

The second objective is to identify the impact of AI economy development on innovative culture and the quality of higher education. For this purpose, a factor analysis is conducted, resulting in the creation of a regression model that examines the influence of AI economy factors (EAI) on the indicators of innovative culture development (ICD) and higher education quality (HEQ). Factors that exert a systemic positive impact on all outcome variables are selected.

The third objective is to determine the prospects for developing an innovative culture and improving the quality of higher education based on the AI economy in Uzbekistan. To this end, the authors developed a proprietary forecast, projecting changes in ICD and HEQ indicators under the maximization of the selected EAI indicators. The required increase in all modifiable indicator values is assessed to fully unlock the potential of AI in supporting the development of innovative culture and enhancing the quality of higher education in Uzbekistan.

4. RESULTS

4.1. Analysis of the Achieved Level of the Development of Innovation Culture, AI Economy, and Quality of Education in Uzbekistan

The solution of the first task lies in the consideration of the development of the AI economy, innovation culture, and quality of education in Uzbekistan in 2024 identified and demonstrated in Figure 1, established by comparing the values of indicators in Uzbekistan with arithmetic averages for SCA.

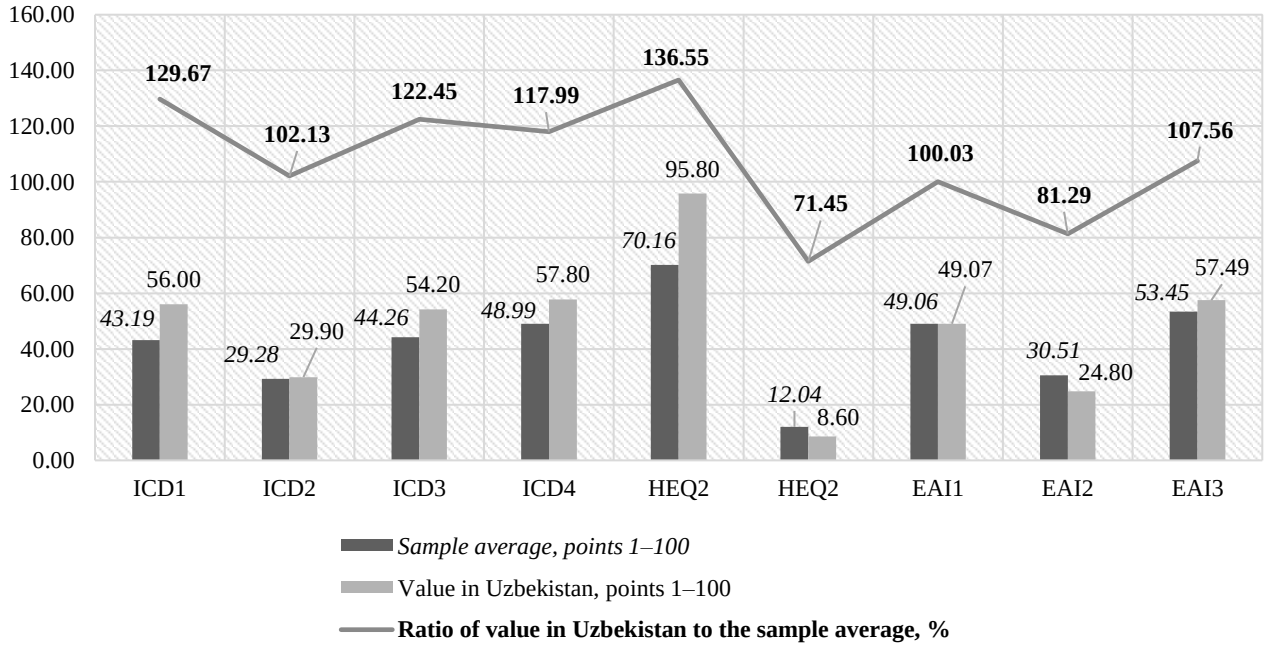

Figure 1. Development of AI economy, innovation culture, and quality of education in Uzbekistan in 2024.
Source: Developed by the authors.

As shown by the results of the comparative analysis in Figure 1, the prevalence of collaborative partnerships between universities and industries in Uzbekistan in 2024 (56.00 points) is 29.67% higher than the SCA average (43.19 points). Similarly, the intensity of introducing innovative products to the market in Uzbekistan in 2024 (29.90 points) is 2.13% higher than the SCA average (29.28 points). The prominence of research institutions in Uzbekistan in 2024 (54.20 points) is 22.45% higher than the SCA average (44.26 points).

Additionally, the scale of activity of innovative companies in Uzbekistan in 2024 (57.80 points) is 17.99% higher than the SCA average (48.99 points). Employment opportunities for individuals with higher education in Uzbekistan in 2024 (95.80 points) are 36.55% higher than the SCA average (70.16 points). However, labor productivity in Uzbekistan in 2024 (8.60 points) is 28.55% lower than the SCA average (12.04 points).

The level of the development of AI-based e-government in Uzbekistan in 2024 (47.06 points) is at the average level for SCA (47.06 points). The activity of applied use of AI technologies in Uzbekistan in 2024 (24.80 points) is 18.29% lower than the SCA average (30.51 points). The accessibility of data and AI economy infrastructure in Uzbekistan in 2024 (57.49 points) is 7.56% higher than the SCA average (53.45 points).

Thus, Uzbekistan has achieved a relatively high level of development in the AI economy and the quality of higher education, along with an outstanding innovative culture. Across most statistical indicators, Uzbekistan surpasses the SCA average in 2024. Therefore, the country became a regional leader in advancing the AI economy and deriving socio-economic benefits from its development.

4.2. Implications of the AI Economy for Innovation Culture and Quality of Higher Education

The solution to the first research objective is regression statistics characterizing the effects of the AI economy on the innovation culture and quality of higher education. The results of factor analysis of the data from Table 1 are shown in Tables 2, 3 and 4.

Table 2. Regression statistics for ICD_1 and ICD_2.

Area of analysis	Parameters for ICD_1				Parameters for ICD_2			
Dispersion analysis	-	Regression	Residual	Total	-	Regression	Residual	Total
	df	3	10	13	df	3	10	13
	SS	30.8499	1060.7672	1091.6171	SS	3205.8602	3995.7109	7201.5711
	MS	10.2833	106.0767	-	MS	1068.6201	399.5711	-
F-test	Significance F	α	F tabular	F observed	Significance F	α	F tabular	F observed
	0.9600	-	-	0.0969	0.1041	0.15	2.2086	2.6744
Coefficients	Constant	E_{AI1}	E_{AI2}	E_{AI3}	Constant	E_{AI1}	E_{AI2}	E_{AI3}
	37.2301	-0.0301	0.2164	0.0155	85.8450	-1.0854	-0,2589	0.0855
Regression statistics	R	Standard error at			R	Standard error at		
		E_{AI1}	E_{AI2}	E_{AI3}		E_{AI1}	E_{AI2}	E_{AI3}
	0.1681	0.3219	0.5426	0.5017	0.6672	0.6247	1.0531	0.9736

Source: Developed by the authors.

The factor analysis results in Table 2 indicate no statistically significant relationship between the prevalence of collaborative partnerships between universities and industries and the factors of the AI economy because the F-test was not passed in the regression statistics for ICD_1. However, the intensity of introducing innovative products to the market is 66.72% determined by the influence of AI economy factors. The statistical significance of the relationship between the examined indicators was confirmed by a successfully passed F-test in the regression statistics for ICD_1 at a significance level of 0.15. The standard errors were relatively small, amounting to 0.6247 for E_{AI1}, 1.0531 for E_{AI2}, and 0.9736 for E_{AI3}.

Table 3. Regression statistics for ICD_3 and ICD_4.

Area of analysis	Parameters for ICD_3				Parameters for ICD_4			
Dispersion analysis	-	Regression	Residual	Total	-	Regression	Residual	Total
	df	3	10	13	df	3	10	13
	SS	3364.0628	2957.2894	6321.3521	SS	28.5431	672.3740	700.9171
	MS	1121.3543	295.7289	-	MS	9.5144	67.2374	-
F-test	Significance F	α	F tabular	F observed	Significance F	α	F tabular	F observed
	0.0473	0.05	3.7083	3.7918	0.9328	-	-	0.1415
Coefficients	Constant	E_{AI1}	E_{AI2}	E_{AI3}	Constant	E_{AI1}	E_{AI2}	E_{AI3}
	-27.9994	-0.0857	1.8488	0.3755	40.1998	-0.0349	-0.0905	0.2480
Regression statistics	R	Standard error at			R	Standard error at		
		E_{AI1}	E_{AI2}	E_{AI3}		E_{AI1}	E_{AI2}	E_{AI3}
	0.7295	0.5374	0.9060	0.8376	0.2018	0.2563	0.4320	0.3994

Source: Developed by the authors.

The results of the factor analysis in Table 2 indicate no statistically significant relationship between the scale of activity of innovative companies and the factors of the AI economy, as the F-test was not passed in the regression

statistics for ICD_4. However, the prominence of research institutions is 53.74% determined by the influence of AI economy factors. The statistical significance of the relationship between the analyzed indicators was confirmed by a successfully passed F-test in the regression statistics for ICD_3 at a significance level of 0.05. The standard errors were relatively small, amounting to 0.5374 for E_{AI1}, 0.9060 for E_{AI2}, and 0.8376 for E_{AI3}.

Table 4. Regression statistics for HEQ_1 and HEQ_2.

Area of analysis	Parameters for HEQ_1				Parameters for HEQ_2			
Dispersion analysis	-	Regression	Residual	Total	-	Regression	Residual	Total
	df	3	10	13	df	3	10	13
	SS	1710.3592	1360.5751	3070.9343	SS	388.8589	594.5933	983.4521
	MS	570.1197	136.0575	-	MS	129.6196	59.4593	-
F-test	Significance F	α	F tabular	F observed	Significance F	α	F tabular	F observed
	0.0367	0.05	3.7083	4.1903	0.1535	0.20	1.8614	2.1800
Coefficients	Constant	E_{AI1}	E_{AI2}	E_{AI3}	Constant	E_{AI1}	E_{AI2}	E_{AI3}
	60.1461	-0.0071	-1.9444	1.3037	-22.1028	0.0178	0.0928	0.5694
Regression statistics	R	Standard error at			R	Standard error at		
		E_{AI1}	E_{AI2}	E_{AI3}		E_{AI1}	E_{AI2}	E_{AI3}
	0.7463	0.3645	0.6145	0.5681	0.6288	0.2410	0.4063	0.3756

Source: Developed by the authors.

The results of the factor analysis in Table 2 indicate that employment opportunities for individuals with higher education are 74.63% influenced by factors of the AI economy. The statistical significance of the relationship between the examined indicators was confirmed by a successfully passed F-test in the regression statistics for ICD_3 at a significance level of 0.05. The standard errors were relatively small, amounting to 0.3645 for HEQ_1, 0.6145 for E_{AI2}, and 0.5681 for E_{AI3}.

Similarly, labor productivity is 62.88% influenced by factors of the AI economy. The statistical significance of the relationship between the analyzed indicators was confirmed by a successfully passed F-test in the regression statistics for ICD_3 at a significance level of 0.20. The standard errors were relatively small, amounting to 0.2410 for HEQ_2, 0.4063 for E_{AI2}, and 0.3756 for E_{AI3}.

Based on the systematization of the statistically significant results from the factor analysis, the following regression model was developed to represent the influence of AI economy factors (E_{AI}) on the indicators of innovative culture development (ICD) and the quality of higher education (HEQ):

$$\begin{cases} ICD_2=85.8450-1.0854E_{AI1}-0.2589E_{AI2}+0.0855E_{AI3}, \\ ICD_3=-27.9994-0.0857E_{AI1}+1.8488E_{AI2}+0.3755E_{AI3}, \\ HEQ_1=60.1461-0{,}0071E_{AI1}-1.9444E_{AI2}+1.3037E_{AI3}, \\ HEQ_2=-22.1028+0.0178E_{AI1}+0.0928E_{AI2}+0.5694E_{AI3}. \end{cases} \quad (1)$$

Model (1) indicates that a one-point increase in the level of AI-based e-government development results in a 0.0178-point increase in labor productivity. A one-point rise in the activity of applied use of AI technologies leads to a 1.8488-point increase in the prominence of research institutions and a 0.0928-point increase in labor productivity. A one-point improvement in the accessibility of data and AI economy infrastructure results in a 0.0855-point increase in the intensity of introducing innovative products to the market, a 0.3755-point increase in the prominence of research institutions, a 1.3037-point increase in employment opportunities for individuals with higher education, and a 0.5694-point increase in labor productivity.

Thus, the only factor of the AI economy that has a systemically positive impact on all outcome variables is the accessibility of data and AI economy infrastructure (E_{AI3}). Optimizing the influence of this factor is key to unlocking AI's potential to support the development of innovative culture and enhance the quality of higher education in Uzbekistan, as well as in other SCA countries.

4.3. Prospect of Development of Innovation Culture and Quality Improvement of Higher Education on the basis of AI Economics in Uzbekistan

The solution to the first objective of this research is the identified prospect for developing an innovative culture and improving higher education quality based on the AI economy in Uzbekistan. This prospect through 2028 is reflected in the authors' forecast (Figure 2), showing changes in ICD and HEQ indicators under the maximization of the selected E_{AI3} factor. Figure 2 also evaluates the necessary growth in all modifiable indicators to fully unlock the potential of AI in supporting the development of innovative culture and enhancing the quality of higher education in Uzbekistan.

According to the authors' forecast in Figure 2, to fully unlock the potential of AI in supporting the development of innovative culture and improving the quality of higher education in Uzbekistan by 2028, it is recommended to increase the accessibility of data and AI economy infrastructure by 73.94% – from 57.49 points in 2024 to 100.00 points by 2028. Implementing this recommendation will achieve the following:

- Increase the intensity of bringing innovative products to market by 11.55%: from 29.90 points in 2024 to 33.35 points by 2028;

- Increase in the status of research institutes by 33.52%: from 54.20 points in 2024 to 72.37 points by 2028.

Second, the implementation of the recommendation will improve the quality of higher education in Uzbekistan as follows:

- Increased employment opportunities for personnel with higher education by 4.38%: from 95.80 points in 2024 to 100.00 points by 2028;
- Increase in labor productivity by 186.98%: from 8.60 points in 2024 to 24.68 points by 2028.

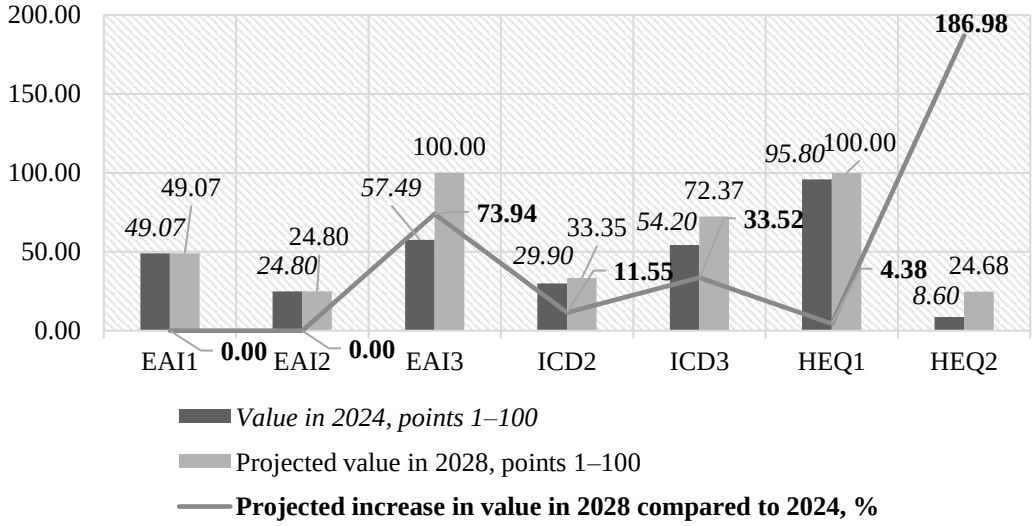

Figure 2. Forecast of development of the AI economy, innovation culture, and quality of education in Uzbekistan until 2028. *Source:* Developed by the authors.

Thus, the impact of AI on innovative culture and the quality of higher education in Uzbekistan can be optimized through the recommended increase in data accessibility and AI economy infrastructure while maintaining the current level of AI-based e-government development and applied use of AI technologies through 2028. This approach will foster the systemic development of innovative culture, enhance the quality of higher education, and maximize the socio-economic benefits of the Fifth Industrial Revolution.

5. DISCUSSION

The contribution of the research findings to the works of Bansal et al. (2024), Ojha and Nikhil (2024), Otarbayeva et al. (2024), Popkova et al. (2024), Pramanik et al. (2024) and Sukhodolov et al. (2018), related to the concept of the AI economy, lies in the in-depth exploration of the applied aspects of the Fifth Industrial Revolution within the socio-economic system of the SCA region. This has enabled a refinement of the understanding of the consequences of AI economy development for innovative culture and the quality of higher education in the SCA (Table 5).

Table 5. The impact of the AI economy on innovation culture and the quality of higher education found in SCA compared to the existing literature *Source:* Developed by the authors.

Influence of factors		Factors of the AI economy: the essence of influence (regression)		
		AI-based development of e-government (Galoyan & Matevosyan, 2023; Kumar et al., 2024)	Applied use of AI technologies (Corea, 2024; Mardonov et al., 2021)	Data and the infrastructure of the AI economy (Morozova et al., 2018; Pachouri et al., 2023)
On innovative culture	On collaborative partnerships between universities and industries (Andekina et al., 2024)	no statistically significant influence was found		
	On the intensity of bringing innovative products to the market (Mkrtchyan et al., 2023)	negative (-1.0854)	negative (-0.2589)	positive (0.0855)
	On the status of research institutes (Abdurakhmanova et al., 2024; Bogoviz et al., 2020)	negative (-0.0857)	positive (1.8488)	positive (0.3755)
	On the scale of activities of innovative companies (Yuldashev et al., 2021)	no statistically significant influence was found		
On the quality of higher education	On employment opportunities for personnel with higher education (Abdurakhmanov et al., 2019; Maxyutova et al., 2022)	negative (-0.0071)	negative (-1.9444)	positive (1.3037)
	On labor productivity (Kaliyeva et al., 2022)	positive (0.0178)	positive (0.0928)	positive (0.5694)

As shown in Table 5, the findings of this research provide a comprehensive answer to the research question by, first, explaining how the three key characteristics of AI economy development affect the socio-economic systems of SCA countries. Specifically, the authors established that the development of AI-based e-government, contrary to the conclusions of Galoyan and Matevosyan (2023) and Kumar et al. (2024), has a negative impact on nearly all manifestations of social progress in SCA countries, contributing only to an increase in labor productivity.

The applied use of AI technologies, contrary to the findings of Corea (2024) and Mardonov et al. (2021), has a contradictory effect on the manifestations of social progress in SCA countries: while improving some aspects (such as increasing the prominence of research universities and boosting labor productivity), it worsens others (reducing the intensity of introducing innovative products to the market and limiting employment opportunities for individuals with higher education). Consistent with the research of Morozova et al. (2018) and Pachouri et al. (2023), this research substantiated that the increased accessibility of data and AI economy infrastructure systematically enhances manifestations of social progress in SCA countries.

Second, the research has clarified the consequences of developing the AI economy for innovative culture and higher education in SCA countries. It was revealed that AI economy factors do not have a statistically significant impact on collaborative partnerships between universities and industries (contrary to Andekina et al. (2024)) or on the scale of activity of innovative companies (contrary to Yuldashev et al. (2021)) in SCA countries.

The impact of AI economy factors on the intensity of introducing innovative products to the market (contrary to Mkrtchyan et al. (2023)), the prominence of research institutions (contrary to Abdurakhmanova et al. (2024) and Bogoviz et al. (2020)), and employment opportunities for individuals with higher education (contrary to Abdurakhmanov et al. (2019) and Maxyutova et al. (2022)) is contradictory in SCA countries. Only labor productivity, consistent with the conclusions of Kaliyeva et al. (2022), is comprehensively and positively influenced by AI economy factors in SCA countries.

Thus, the conclusions provide a new perspective on the AI economy, characterized by a close connection between scientific and technological progress and social development. As a result, the authors' scientific and practical recommendations support the sustainable development of socio-economic systems in SCA countries within the context of the Fifth Industrial Revolution. These recommendations enable the simultaneous transition to Industry 5.0 in entrepreneurship and public governance while enhancing the quality of higher education and fostering an innovative culture.

The key distinction of these findings compared to previous literature is the demonstration that the development of the AI economy does not necessarily contradict the idea of social progress. Instead, it requires flexible government and corporate governance to unlock its potential in supporting higher education and innovation. From a cultural perspective, the transition to Industry 5.0 is not synonymous with cultural decline; rather, it signifies the emergence of a new culture of science, higher education, technology, and innovation.

In this context, the new findings of this research made it possible to rethink the social risks associated with the development of the AI economy and the creation of a methodological foundation for social risk management during the Fifth Industrial Revolution. The forecast and authors' recommendations extend the series of studies by Abdurashidova and Balbaa (2023), Eshov et al. (2023), Kobilov et al. (2023), and Shakib Kotamjani et al. (2023) on the AI economy development in Uzbekistan.

6. CONCLUSION

The key findings of this research, which collectively achieved the research objectives, are as follows:

1) A high level of AI economy development, higher education quality, and an outstanding innovative culture in Uzbekistan in 2024 were identified compared to the average levels in SCA countries. These findings underscore Uzbekistan's leadership in the region in terms of its engagement with the Fifth Industrial Revolution;
2) An econometric model was developed to analyze the influence of AI economy factors on the indicators of innovative culture development and higher education quality in SCA countries. The model revealed causal relationships in the development of the AI economy and identified its potential to support innovative culture and improve higher education quality, reflecting the theoretical significance of the model;
3) A broad prospect for developing an innovative culture and improving higher education quality based on the AI economy in Uzbekistan was established, supported by the forecast through 2028. The practical significance of the forecast lies in its potential to serve as a roadmap for advancing innovative culture and enhancing higher education quality through the development of the AI economy in Uzbekistan during this period. The authors' recommendations, aimed at fully unlocking AI's potential to support innovative culture and improve higher education quality in Uzbekistan, are of managerial importance.

The proposed benchmark values for the indicators can serve as target guidelines for developing the AI economy in Uzbekistan, where they were specifically designed, and other SCA countries, which, as the

research results show, share common patterns of social progress as their AI economies develop.

The temporal boundary of the forecast and recommendations (i.e., 2028) is conditional. If, for any reason, the target statistical values are not achieved in Uzbekistan or other SCA countries by 2028, the process of transitioning to Industry 5.0 may be extended to a later period, such as 2030 or beyond. It should be emphasized that a rapid pace of AI economy development while enabling countries to strengthen their positions in global high-tech markets, is undesirable from the perspective of social progress. This is because it carries significant risks of degrading innovative culture and diminishing the quality of higher education.

To support social progress, it is essential to cautiously and systemically develop the AI economy by complementing economic and technological reforms with social measures. These include supporting employment, encouraging lifelong learning, and promoting socially responsible AI innovations. Such an approach can harmonize economic development with social progress in the context of the growing adoption of AI-based smart technologies.

The conclusion is that transitioning to Industry 5.0 in Uzbekistan is appropriate. However, to optimize AI's contribution to the development of innovative culture and the improvement of higher education quality by 2028, it is necessary to increase the accessibility of data and AI economy infrastructure. This should be achieved while maintaining the 2024 level of AI-based e-government development and the applied use of AI technologies.

The authors' conclusions and practical developments presented in this research also hold social significance because they align the AI economy with societal needs. Implementing the authors' recommendations will unlock AI's potential to support the development of innovative culture and enhance the quality of higher education in SCA countries, particularly in Uzbekistan, for which the most detailed scientific and practical recommendations have been proposed.

The scientific novelty of the results lies in highlighting the unique experiences of SCA countries, which belong to the category of developing nations and have relatively recently engaged with the Fifth Industrial Revolution. The experience of SCA countries is valuable for other developing nations either interested in transitioning to Industry 5.0 or seeking to accelerate this transition process. The limitations of this study's results are as follows.

The first limitation is the lack of detailed statistical records for all SCA countries, which is required for such an in-depth study of socio-economic processes related to the spread of AI technologies. For instance, the "Knowledge for All" (Dutta et al., 2024) dataset does not provide statistics for certain SCA countries, such as Afghanistan, the Maldives, Syria, and Turkmenistan. Consequently, the practical experiences of these countries in developing their AI economies could not be considered in this research.

The second limitation lies in the lack of convincing scientific evidence in this research regarding the influence of the AI economy on collaborative partnerships between universities and industries, as well as on the scale of activity of innovative companies. The insufficient statistical significance of the established regression relationships does not necessarily indicate the absence of a factual connection between the studied indicators. It may instead be a consequence of the limited size of the data sample.

To address these limitations, future studies building on this research should focus on empirical, possibly case-based, research into the development of the AI economy in SCA countries such as Afghanistan, the Maldives, Syria, and Turkmenistan. Additionally, it would be advisable to construct large-scale datasets, potentially comprising extensive time series covering statistics over several years. These datasets could then be used to refine the regression relationships between various manifestations of social progress and the development of the AI economy in SCA countries.

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