RESEARCH PAPER / ОРИГИНАЛЬНАЯ СТАТЬЯ
МРНТИ 06.52.17
JEL: O33, O47, R11
https://doi.org/10.58732/2958-7212-2026-1-143-158

Assessment of the Impact of Digital Factors on the Quality of Higher Education in Kazakhstan

Aisulu Dzhanegizova[a], Marat Urdabayev[a], Akan Nurbatsin[b]*

[a]Al-Farabi Kazakh National University, Almaty, Kazakhstan
[b]University of International Business named after K. Sagadiyev, Almaty, Kazakhstan

ABSTRACT

In the context of the accelerating digital transformation of the economy, the importance of quantifying the impact of digital factors on the effectiveness of the higher education system is increasing. The purpose of the study is to analyze the impact of digitalization on the effectiveness of the educational process in higher education institutions in Kazakhstan. The methodological basis of the work consists of quantitative analysis methods, including the calculation of relative indicators of digitalization and educational effectiveness, as well as econometric modeling using the least squares method (OLS). The empirical base of the study was made up of statistical data from the Bureau of National Statistics of the Republic of Kazakhstan, including indicators of the number of students, graduates, teachers, as well as the provision of universities with computer technology and Internet access. The results of the study show that during the analyzed period, the availability of Internet computers increased from 11.64 to 13.28 units per 100 students (+14.1%), while the graduation rate increased from 23.57% to 26.51% (+2.94 p.p.). The econometric analysis revealed a positive relationship between the level of digitalization and the effectiveness of the educational process: an increase in the availability of Internet computers by 1 unit per 100 students is accompanied by an increase in the graduation rate by an average of 2.09 percentage points (R2 = 0.874). The results show that digitalization is a significant factor in improving the effectiveness of higher education, but its impact is primarily quantitative and does not fully reflect qualitative changes in graduate training.

ARTICLE HISTORY
Received:21 October 2025
Revised: 30 January 2026
Accepted: 27 February 2026
Published: 30 March 2026

KEYWORDS
Higher Education; Educational Policy; Social Factor; Human capital; University; Digitalization; Digital Infrastructure

FINANCIAL SUPPORT
This study funded by the Science Committee MSHE RK (BR24992974 "Modernisation of the higher education quality assurance system in Kazakhstan through digitalisation: development of approaches, mechanisms, and an information framework")

Check for updates

Conflict of interest: author(s) declare that there is no conflict of interest

***Corresponding author:** Nurbatsin A. – PhD, University of International Business named after K. Sagadiyev, Almaty, Kazakhstan, email: nurbatsin.a@uib.kz

For citation: Dzhanegizova, A., Urdabayev, M. & Nurbatsin, A.(2026). Assessment of the Impact of Digital Factors on the Quality of Higher Education in Kazakhstan. Qainar Journal of Social Science, 5(1),143-158. https://doi.org/10.58732/2958-7212-2026-1-143-158

Қазақстандағы жоғары білім сапасына цифрлық факторлардың әсерін бағалау

Джанегизова А.[а], Урдабаев М.[а], Нурбацин А.[б]*

[а]әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан
[б]Қ. Сағадиев атындағы Халықаралық бизнес университеті, Алматы, Қазақстан

ТҮЙІН

Экономиканың жедел цифрлық трансформациясы жағдайында жоғары білім беру жүйесінің тиімділігіне цифрлық факторлардың әсерін сандық тұрғыдан бағалаудың маңыздылығы артып келеді. Зерттеудің мақсаты Қазақстандағы жоғары оқу орындарында білім беру процесінің нәтижелілігіне цифрландырудың әсерін талдау болып табылады. Зерттеудің әдіснамалық негізін цифрландыру және білім беру тиімділігінің салыстырмалы көрсеткіштерін есептеуді, сондай-ақ ең кіші квадраттар әдісін (OLS) қолдана отырып эконометриялық модельдеуді қамтитын сандық талдау әдістері құрайды. Зерттеудің эмпирикалық базасын Қазақстан Республикасы Ұлттық статистика бюросының студенттер, түлектер, оқытушылар саны, сондай-ақ жоғары оқу орындарының компьютерлік техникамен және интернетке қолжетімділікпен қамтамасыз етілу көрсеткіштерін қамтитын статистикалық деректері құрайды. Зерттеу нәтижелері көрсеткендей, қарастырылған кезеңде интернетке қосылған компьютерлермен қамтамасыз етілу 100 студентке шаққанда 11,64-тен 13,28 бірлікке дейін артқан (+14,1%), ал түлектер коэффициенті 23,57%-дан 26,51%-ға дейін өскен (+2,94 п.т.). Эконометриялық талдау цифрландыру деңгейі мен білім беру процесінің нәтижелілігі арасында оң өзара байланыс бар екенін көрсетті: интернетке қосылған компьютерлермен қамтамасыз етілу деңгейінің 100 студентке шаққанда 1 бірлікке артуы түлектер коэффициентінің орта есеппен 2,09 пайыздық тармаққа өсуімен қатар жүреді (R^2 = 0,874). Алынған нәтижелер цифрландырудың жоғары білім беру тиімділігін арттырудағы маңызды фактор екенін дәлелдейді, алайда оның әсері негізінен сандық сипатқа ие және түлектерді даярлау сапасының сапалық өзгерістерін толық көлемде көрсетпейді.

МАҚАЛАНЫҢ ТАРИХЫ
Қабылданды: 21 қараша 2025
Қайта қаралды: 30 қазан 2026
Жариялауға қабылданды: 27 ақпан 2026
Жарияланды: 30 наурыз 2026

ТҮЙІН СӨЗДЕР
жоғары білім; білім беру саясаты; әлеуметтік фактор; адами капитал; университет;цифрландыру; цифрлық инфрақұрылым

ҚАРЖЫЛАНДЫРУ
Зерттеу ҚР ҒЖБМ Ғылым комитеті қаржыландырған (BR24992974 «Цифрландыру негізінде Қазақстанда жоғары білім сапасын қамтамасыз ету жүйесін жаңғырту: тәсілдерді, тетіктерді және ақпараттық базаны әзірлеу»)

Мүдделер қақтығысы: автор(лар) мүдделер қақтығысының жоқтығын мәлімдейді

***Хат-хабаршы авторы:** Нурбацин А. – PhD, Қ. Сағадиев атындағы Халықаралық бизнес университеті, Алматы, Қазақстан, email: nurbatsin.a@uib.kz

Дәйексөз үшін: Джанегизова А., Урдабаев М., Нурбацин А. (2026). Қазақстандағы жоғары білім сапасына цифрлық факторлардың әсерін бағалау. Қайнар әлеуметтік ғылымдар журналы, 5(1),143-158. https://doi.org/10.58732/2958-7212-2026-1-143-158

Оценка влияния цифровых факторов на качество высшего образования в Казахстане

Джанегизова А.[а], Урдабаев М.[а], Нурбацин А.[б]*

[а]Казахский национальный университет им. Аль-Фараби, Алматы, Казахстан
[б]Университет международного бизнеса им. К. Сагадиева, Алматы, Казахстан

АННОТАЦИЯ

В условиях ускоряющейся цифровой трансформации экономики возрастает значимость количественной оценки влияния цифровых факторов на эффективность системы высшего образования. Цель исследования заключается в анализе влияния цифровизации на результативность образовательного процесса в высших учебных заведениях Казахстана. Методологическую основу работы составляют методы количественного анализа, включая расчет относительных показателей цифровизации и образовательной эффективности, а также эконометрическое моделирование с использованием метода наименьших квадратов (OLS). Эмпирическую базу исследования составили статистические данные Бюро национальной статистики Республики Казахстан, включающие показатели численности студентов, выпускников, преподавателей, а также обеспеченности вузов компьютерной техникой и интернет-доступом. Результаты исследования показывают, что за анализируемый период обеспеченность интернет-компьютерами увеличилась с 11,64 до 13,28 единиц на 100 студентов (+14,1%), в то время как коэффициент выпуска вырос с 23,57% до 26,51% (+2,94 п.п.). Эконометрический анализ выявил положительную взаимосвязь между уровнем цифровизации и результативностью образовательного процесса: увеличение обеспеченности интернет-компьютерами на 1 единицу на 100 студентов сопровождается ростом коэффициента выпуска в среднем на 2,09 процентного пункта (R^2 = 0,874). Полученные результаты свидетельствуют о том, что цифровизация выступает значимым фактором повышения эффективности высшего образования, однако ее влияние носит преимущественно количественный характер и не в полной мере отражает качественные изменения в подготовке выпускников.

ИСТОРИЯ СТАТЬИ
Получено: 21 октября 2025
Доработано: 30 января 2026
Принято: 27 февраля 2026
Опубликовано: 30 марта 2026

КЛЮЧЕВЫЕ СЛОВА
высшее образование; образовательная политика; социальный фактор; человеческий капитал; университет;цифровизация; цифровая инфраструктура

ФИНАНСИРОВАНИЕ
исследование выполнено при финансовой поддержке Комитета науки МНВО РК (BR24992974 «Модернизация системы обеспечения качеств высшего образования в Казахстане на основе цифровизации: разработка подходов, механизмов и информационной базы»)

Конфликт интересов: авторы заявляют об отсутствии конфликта интересов

***Автор-корреспондент:** Нурбацин А. – PhD, Университет международного бизнеса им. К. Сагадиева, Алматы, Казахстан, email: nurbatsin.a@uib.kz

Дәйексөз үшін: Джанегизова А., Урдабаев М., Нурбацин А. (2026). Оценка влияния цифровых факторов на качество высшего образования в Казахстане. Кайнар журнал социальных наук, 5(1),143-158. https://doi.org/10.58732/2958-7212-2026-1-143-158

1. Introduction

In the context of the rapid development of the digital economy, the higher education system is becoming a key factor in the formation of human capital and in ensuring sustainable socio-economic growth. Digitalization is transforming not only production and management processes, but also the structure of demand for skills, increasing the importance of digital competencies, analytical thinking and interdisciplinary training. In these circumstances, higher education must adapt to new requirements by providing training for professionals who can function effectively in a digital environment.

In the context of the formation of the digital economy, the higher education system is becoming a key element in developing human capital and ensuring sustainable socio-economic growth. Digitalization is transforming not only production processes, but also competence requirements, increasing the importance of digital skills, analytical thinking and interdisciplinary training. Under these conditions, higher education assumes the role of a complex sociotechnical system that integrates digital technologies, educational analytics, and new forms of interaction between participants in the educational process (Hanushek & Woessmann, 2008; Frank et al., 2019; Acemoglu & Restrepo, 2020; Selwyn, 2016).

The evolution of scientific approaches to the analysis of higher education reflects the transition from the classical theory of human capital, which treats education as an investment to increase productivity and income (Becker, 1993), to modern concepts of universities' digital transformation. Modern research shows that digital technologies are not an end in themselves, but a tool for improving the effectiveness of staff training, expanding access to knowledge, and adapting graduates to the demands of the new economy (Hanushek & Woessmann, 2008; Psacharopoulos & Patrinos, 2004). At the same time, educational analytics technologies and the use of big data are of particular importance, enabling the personalisation of educational trajectories and improving learning outcomes (Siemens & Long, 2011; Ferguson, 2012).

In countries with economies in transition, including Kazakhstan, these processes are accompanied by institutional transformations in higher education, including the expansion of university autonomy and integration into the global educational space (Azimbayeva, 2017; Zenkova & Khamitova, 2018). In addition, the modernisation of the system is accompanied by sociocultural changes and the emergence of hybrid models of higher education that combine international and national characteristics (Lodhi & Ilyassova-Schoenfeld, 2022).

Modern research on Kazakhstan shows that digitalization contributes to expanding access to educational resources, developing distance learning and improving the effectiveness of educational process management. Still, its effectiveness depends on the level of digital infrastructure, teachers' competencies, and universities' institutional readiness (Nurtayeva et al., 2024). At the same time, it is emphasized that higher education reforms are implemented through mechanisms for adapting international models, forming a specific institutional environment, and the higher education system itself is an important driver of national development (Kireyeva, 2025).

Despite the significant contribution of existing research, there are still unresolved issues related to the comprehensive assessment of the impact of digitalization on the quality of higher education. In particular, the relationship between the level of digital infrastructure, the effectiveness of the educational process and the formation of human capital has not been sufficiently studied, especially in countries with economies in transition. This necessitates a quantitative analysis to assess the impact of digital factors on educational outcomes empirically.

The purpose of the study is to analyze the impact of digitalization on the effectiveness of the educational process in the higher education system of Kazakhstan.

2. Literature review

Analysis of current trends in higher education in the context of the digitalization of the economy in chronological logic from classical theoretical approaches to modern research on the digital transformation of universities. This approach allows us to trace the evolution of ideas about the role of higher education. In particular, from a tool for accumulating human capital to a complex digital ecosystem related to the quality of education, data management, international competitiveness and the introduction of artificial intelligence technologies (Gorshenin, 2018; Carmo et al., 2025; Al-Dmour et al., 2025).

Within the framework of classical economic theory, the starting point for the analysis of education is G. Becker's concept of human capital. In Becker (1993), education is considered an investment that contributes to increased productivity, income, and overall economic returns on human resources. This logic remains relevant in modern higher education research, as it allows us to consider digitalization not as an end in itself, but as a tool to improve the effectiveness of personnel training and the quality of human capital (Hanushek & Woessmann, 2008). In other words, the importance of digital technologies is determined by their contribution to improving learning outcomes, expanding access to knowledge, and increasing graduates' adaptability to the demands of the new economy (Psacharopoulos & Patrinos, 2004; Fleischhauer, 2007).

The next stage in the development of scientific ideas is associated with the formation of the concept of the digital transformation of higher education, in which universities are considered complex sociotechnical systems that rely on digital platforms, educational analytics, and network-based forms of interaction. Research highlights that digital technologies are changing not only the forms of education, but also the institutional logic of university functioning, including management models, quality assessment mechanisms, and ways of interacting with the labor market (Selwyn, 2016). Of particular importance is the development of learning analytics and data-driven approaches that make it possible to personalize educational trajectories, increase learning efficiency, and make management decisions based on big data analysis (Siemens & Long, 2011; Ferguson, 2012).

In more recent studies, the focus has shifted to assessing the impact of digital technologies and artificial intelligence on educational outcomes and the formation of skills in demand in the labor market (Frank et al., 2019; Acemoglu & Restrepo, 2020). In the context of national educational systems, these processes are reflected in research on the modernization of higher education in post-Soviet countries, including Kazakhstan. In particular, it is shown that the reform of the higher education system was accompanied by changes in management models, the expansion of institutional autonomy, and integration into the global educational space (Azimbayeva, 2017; Zenkova & Khamitova, 2018). An additional development of this issue is presented in studies on the institutional and socio-cultural aspects of the transformation of higher education in Kazakhstan. In particular, the study by Duisenova et al. (2020) demonstrates that the choice of educational trajectories is increasingly determined by employment expectations, competitiveness, and demand for skills, reflecting the growing relationship between the higher education system and the knowledge economy. Modernization of the educational system is accompanied not only by

structural reforms, but also by changes in the language and academic environment (Goodman & Kambatyrova, 2022).

A significant contribution to understanding the specifics of the Kazakh model of higher education was made by works on post-Bolonian reforms. Research shows that after Kazakhstan joined the Bologna process, the higher education system became more institutionally differentiated, and government policy increasingly focused on university autonomy, internationalization, and compliance with international quality standards (Hartley et al., 2016; Ahn et al., 2018). A significant contribution to understanding the specifics of the Kazakh model of higher education was made by works on post-Bolonian reforms. Ahn et al. (2018) show that after Kazakhstan joined the Bologna process, the higher education system became more institutionally differentiated, and government policy increasingly focused on university autonomy, internationalization, and compliance with international quality standards. At the same time, it is noted that the reforms of the higher education system included structural changes aimed at increasing access to education, introducing a multi-level training system, developing quality assurance mechanisms and strengthening international integration (Massyrova et al., 2015). Kazakhstan's accession to the Bologna process was accompanied not only by borrowing formal elements of the European model but also by their transformation to take into account the national context, leading to the formation of a hybrid model of higher education (Lodhi & Ilyassova-Schoenfeld, 2022). These transformations contributed to the complication of the institutional structure of higher education and the formation of new management and educational practices.

Modern research on the transformation of higher education in Kazakhstan increasingly focuses on the institutional and socio-cultural aspects of the modernization of the system. In particular, it is shown that higher education reforms are largely implemented through mechanisms of borrowing educational policy, in which international models adapt to the national context, forming hybrid institutional solutions (Agbo et al., 2023). Narbaev et al. (2025) based on bibliometric and scientific-metric analysis, it is shown that over the past decade, the system of higher education and science in Kazakhstan has undergone significant changes associated with increased research activity, internationalization and the introduction of digital tools in educational and scientific processes. From an economic perspective, higher education in Kazakhstan is a key driver of national development in a transitional economy, fostering human capital and supporting the economy's structural transformation (Kireyeva, 2025).

Nurtayeva et al. (2024) focus on the applied aspects of the introduction of digital technologies in the activities of higher education institutions in Kazakhstan. The paper shows that digitalization contributes to increasing the availability of educational resources, the development of distance learning and the optimization of management processes, but its effectiveness largely depends on the level of digital infrastructure, the competencies of teachers and the institutional readiness of universities for change. At the same time, the research highlights the presence of socio-cultural contradictions in the development of the higher education system associated with a combination of the processes of internationalization and nationalization of educational policy. In particular, it is noted that the focus on global standards and the use of English coexist with the strengthening of national identity and language policy, which forms a complex institutional environment for the functioning of universities (Bayetova & Robertson, 2024).

Thus, the analysis of scientific literature shows that research on higher education in the context of digitalization is formed at the junction of several theoretical and applied areas: the theory

of human capital, the concept of digital transformation of universities, approaches to the formation of digital skills, as well as the institutional analysis of higher education reforms. At the same time, modern works pay special attention to the impact of digital technologies and artificial intelligence on the quality of education, the development of competencies, and the competitiveness of graduates.

Despite the significant contributions of existing research, a number of unresolved issues remain in the scientific literature. First, most studies consider digitalization either at the macro level, while a comprehensive analysis combining institutional, technological, and socio-economic aspects remains limited. Secondly, the specifics of the digital transformation of higher education in countries with economies in transition, including Kazakhstan, where digitalization is taking place under the simultaneous influence of global trends and national institutional features, have not been sufficiently studied. In addition, existing research has not sufficiently disclosed the relationship between the digitalization of higher education, the quality of human capital and the regional differentiation of educational outcomes. This is especially true in Kazakhstan, where differences in the level of digital infrastructure, access to educational resources, and universities' institutional capabilities can significantly affect the effectiveness of digital transformation.

3. Research methods

In the context of the digitalization of the economy, a quantitative assessment of the impact of digital factors on the quality of higher education is becoming particularly relevant. Despite the presence of a significant number of theoretical and qualitative studies, empirical work based on a statistical analysis of the digitalization of the educational system in Kazakhstan remains limited. In this regard, this study uses a quantitative approach based on the analysis of official statistical data and the construction of an econometric model.

The empirical basis of the study comprised data from the Bureau of National Statistics of the Republic of Kazakhstan (Bureau of National Statistics, 2025), reflecting the dynamics of higher education development over the 2019/2020-2023/2024 academic years. The indicators of the number of students, graduates, and teaching staff were used, along with data on universities' material and technical base, including the availability of computer technology and interactive equipment.

The choice of this time interval is due to the availability of comparable statistical data and the need to analyze the current stage of the digital transformation of higher education, including the post-pandemic period.

To quantify the impact of digitalization on the quality of higher education, a system of indicators has been developed that includes a dependent variable, a key explanatory variable, and a set of additional indicators. The output coefficient was used as a dependent variable for the pilot assessment by formula (1):

$$Q_t = \frac{Graduates_t}{Students_t} \times 100 \qquad (1)$$

where:

Q_t – the quality indicator (conditional performance indicator),

$Graduates_t$ – the number of university graduates,

$Students_t$ – the total number of students.

The choice of this indicator is determined by its accessibility, comparability and the ability to reflect the effectiveness of the educational process on an aggregated level. The main indicator of digitalization is the level of digital provision, measured by the number of computers with Internet access per 100 students, as defined in formula (2):

$$D_t = \frac{InternetComputer_t}{Students_t} \times 100 \quad (2)$$

where:

D_t – the level of digitalization of the higher education system during the t;

$InternetComputers_t$ – the number of computers with Internet access in higher education institutions during the period t;

$Students_t$ – the total number of students in higher education institutions during the period t.

The proposed system of indicators is not exhaustive but is transparent, reproducible, and based on official statistical data, making it suitable for empirical analysis by formula (3):

$$Load_t = \frac{Students_t}{Teachers_t} \quad (3)$$

where:

$Load\_t$ – the average academic load per teacher during the period t;

$Students_t$ – the total number of students in higher education institutions during the period t;

$Teachers_t$ – the number of teaching staff during the period t.

This indicator is used to assess the intensity of the educational process and allows you to indirectly characterize the learning conditions and the quality of interaction between teachers and students. An increase in the value of the indicator indicates an increase in the burden on teachers and may have an impact on the effectiveness of the educational process.

The initial indicators used for model estimation are presented in Table 1.

Table 1. Initial indicators used for model estimation.

Academic year	Students, persons	Graduates, persons	Faculty, persons	Computers, units	Internet access, units	Interactive equipment, units
2019/2020	604,345	142,435	38,470	78,223	70,357	6,069
2020/2021	576,557	153,627	36,307	81,541	76,350	6,131
2021/2022	575,511	151,679	36,378	81,606	75,929	6,062
2022/2023	578,237	161,974	36,404	82,121	77,090	6,213
2023/2024	592,694	157,106	37,391	82,931	78,710	6,975

Note: compiled by the authors based on Bureau of National Statistics (2025).

Table 1 shows the initial data on the higher education system of Kazakhstan for 2019/2020-2023/2024 academic years. It provides data on the number of students, graduates, and faculty. Digital infrastructure indicators are also presented, including the number of computers, Internet devices, and interactive equipment. These data are used in the future to calculate relative indicators and build an econometric model.

The analysis of relative indicators is shown in Table 2.

Table 2. Relative indicators of digitalization and educational performance.

Academic Year	Graduation rate, %	Computers per 100 students	Internet-enabled computers per 100 students	Interactive equipment per 1,000 students	Students per faculty member
2019/2020	23.57	12.94	11.64	10.04	15.71
2020/2021	26.65	14.14	13.24	10.63	15.88
2021/2022	26.36	14.18	13.19	10.53	15.82
2022/2023	28.01	14.20	13.33	10.74	15.88
2023/2024	26.51	13.99	13.28	11.77	15.85

Note: compiled by the authors based on Bureau of National Statistics (2025).

The analysis of the obtained data indicates that over the period 2019/2020–2023/2024, the availability of internet-enabled computers in higher education institutions increased from 11.64 to 13.28 per 100 students (an increase of 14.1%). At the same time, the graduation rate rose from 23.57% to 26.51% (an increase of 2.94 p.p.). These trends suggest a positive relationship between the level of digitalisation and the effectiveness of the educational process.

To quantitatively assess the impact of digitalization on the quality of higher education, a linear regression model of the following form was employed:

$$Q_t = \alpha + \beta D_t + \varepsilon_t \qquad (4)$$

where:

Q_t – the graduation rate;

D_t – the level of digitalization;

α – constant term;

β – c oefficient capturing the effect of digitalization;

ε_t – error term.

The model was estimated using the Ordinary Least Squares (OLS) method based on aggregated annual data. Despite the obtained results, the applied methodological approach has several limitations. First, the analysis relies on aggregated country-level data, which does not allow capturing heterogeneity across individual higher education institutions. Second, the small sample size (five observations) limits the statistical reliability and robustness of the estimates. Third, the selected proxy for educational quality (graduation rate) does not fully reflect the multidimensional nature of educational outcomes, particularly in terms of competencies and graduate employability. Fourth, the model does not account for several potentially important factors, such as funding levels, teaching quality, and internationalization, which may lead to omitted variable bias.

Notwithstanding these limitations, the proposed approach has several advantages. It is based on official statistical data, ensures transparency of calculations, and provides an initial quantitative assessment of the relationship between digitalization and educational outcomes. Moreover, this model can be considered a preliminary stage of a more comprehensive analysis, involving the transition to panel data, expansion of the set of explanatory variables, and the application of more advanced econometric techniques. Thus, the selected methodology provides a balance between data availability and analytical depth, making it suitable for assessing the impact of digitalization on higher education in Kazakhstan at the current stage of statistical development.

4. Results

The analysis of higher education development in the Republic of Kazakhstan under conditions of economic digitalisation reveals sustained quantitative and qualitative transformations affecting both the scale of the system and its technological and institutional structure. During the study period, a simultaneous expansion of student enrollment, growth in digital infrastructure, and a gradual improvement in educational performance indicators can be observed.

First, it is important to highlight changes in the scale and structure of the higher education system. In recent years, student enrollment has increased alongside the optimization of the university network. According to the Bureau of National Statistics, the number of students grew from 604.3 thousand in the 2019/2020 academic year to 678.1 thousand in 2025/2026, representing an increase of more than 12% (Bureau of National Statistics, 2025). At the same time, the number of higher education institutions decreased from 125 to 112 in 2023/2024, followed by stabilization at the level of 113–116 institutions.

The main changes in the higher education system are presented in Table 3.

Table 3. Dynamics of key higher education indicators in Kazakhstan.

Academic year	Number of universities	Students, persons	Faculty, persons
2019/2020	125	604,345	38,470
2020/2021	125	576,557	36,307
2021/2022	122	575,511	36,378
2022/2023	116	578,237	36,404
2023/2024	112	592,694	37,391
2024/2025	113	624,500	37,599
2025/2026	116	678,100	38,014

Note: compiled by the authors based on Bureau of National Statistics (2025).

According to the presented data, the dynamics of the main indicators of the higher education system is shown. During the period under review, the number of universities decreased from 125 in the 2019/2020 academic year to 112 in 2023/2024, after which it stabilized at the level of 113-116. At the same time, the number of students increased from 604.3 thousand to 678.1 thousand, which indicates an expansion in higher education coverage. The number of teachers remained relatively stable and changed from 38.5 thousand to 38.0 thousand, which indicates an increase in the load on the system in the context of an increase in the number of students.

Futhermore, indicators of the digital infrastructure of higher education institutions are presented in Table 4.

Table 4. Digital infrastructure indicators of higher education institutions in Kazakhstan.

Academic year	Computers, units	Internet-enabled computers, units	Share with Internet access, %	Interactive equipment, units
2019/2020	78,223	70,357	89.9	6,069
2020/2021	81,541	76,350	93.6	6,131
2021/2022	81,606	75,929	93.0	6,062
2022/2023	82,121	77,090	93.9	6,213
2023/2024	82,931	78,710	94.9	6,975

Note: compiled by the authors based on Bureau of National Statistics (2025).

From 2019/2020 to 2023/2024, the number of computers increased from 78.2 thousand to 82.9 thousand, and the number of computers with Internet access increased from 70.4 thousand to

78.7 thousand. The share of computers with the Internet increased from 89.9% to 94.9%. The number of interactive equipment has also increased from 6.1 thousand to 7.0 thousand, which indicates an improvement in the technical base of universities. The data show that the digital infrastructure of universities in Kazakhstan is gradually developing. There is an increase in the availability of computers and Internet access, as well as an increase in interactive equipment. At the same time, the development is mainly quantitative in nature and requires further improvement in terms of the quality of the use of digital resources.

Table 5. Indicators of digitalization and higher education performance

Academic year	Graduation rate, %	Computers per 100 students	Internet-enabled computers per 100 students	Students per faculty member
2019/2020	23.57	12.94	11.64	15.71
2020/2021	26.65	14.14	13.24	15.88
2021/2022	26.36	14.18	13.19	15.82
2022/2023	28.01	14.20	13.33	15.88
2023/2024	26.51	13.99	13.28	15.85

Note: compiled by the authors based on Bureau of National Statistics (2025).

As shown in the data, the availability of internet-enabled computers increased from 11.64 to 13.28 per 100 students, while the graduation rate rose from 23.57% to 26.51%. This suggests the existence of a positive relationship between the development of digital infrastructure and the effectiveness of the educational process. To quantitatively validate this relationship, an econometric model was constructed to estimate the impact of digitalization on higher education quality. The graduation rate was used as the dependent variable, while the availability of internet-enabled computers served as the explanatory variable.

The estimated regression equation is shown in equation (5):

$$Qt=-0.79+2.09Dt \quad (5)$$

The estimated model parameters indicate a positive relationship between the level of digitalization and the performance of the educational process. In particular, an increase in the availability of internet-enabled computers by one unit per 100 students is associated with an average increase in the graduation rate of 2.09 p.p.

Table 6. Regression analysis results

Indicator	Value
Dependent variable	Graduation rate
Explanatory variable	Internet-enabled computers per 100 students
Coefficient (β)	2.09
Constant	−0.79
R^2	0.874

Note: compiled by the authors

The high value of the coefficient of determination (R^2 = 0.874) indicates that a substantial proportion of the variance in the dependent variable is explained by the model and suggests a good fit to the observed data. This allows digitalization to be considered a statistically significant factor influencing higher education performance at the aggregate level.

At the same time, the results should be interpreted with caution. First, the estimation is based on a limited time sample, which reduces the statistical reliability of the findings. Second, the model is aggregated and does not capture heterogeneity across individual universities. Third, the selected performance indicator (graduation rate) reflects only the quantitative dimension of the educational process and does not fully capture the quality of graduate competencies or labor market outcomes.

Despite these limitations, the econometric results support the hypothesis of a positive impact of digitalization on the efficiency of higher education systems and are consistent with the descriptive trends identified earlier. This suggests that the development of digital infrastructure constitutes an important driver of educational performance, providing a foundation for further transformation of higher education in the context of the digital economy. Overall, the analysis allows for several general conclusions. The development of higher education in Kazakhstan is taking place within a broader process of structural transformation, characterized by the consolidation of educational institutions and growth in student enrollment. At the same time, digital infrastructure continues to expand steadily, forming the basis for the implementation of new educational models.

The identified positive relationship between digitalization and educational performance highlights the significant role of digital technologies in enhancing the efficiency of higher education. This impact is multifaceted and is realized through improved access to educational resources, the development of distance and hybrid learning formats, and the optimization of educational management processes. Thus, the findings confirm that digitalization is one of the key drivers of transformation in Kazakhstan’s higher education system and plays a crucial role in its adaptation to the requirements of the modern digital economy.

5. Discussion

The results show that digitalization plays an important role in the transformation of Kazakhstan's higher education system and has a positive impact on the effectiveness of the educational process. The revealed positive relationship between the level of digital security and the graduation rate is generally consistent with the provisions of the theory of human capital, according to which investments in education contribute to increased efficiency and productivity (Becker, 1993; Hanushek & Woessmann, 2008).

At the same time, the results are consistent with modern approaches to the digital transformation of higher education, where digital technologies are considered as a tool for improving learning efficiency, expanding access to knowledge, and adapting graduates to the demands of the digital economy (Selwyn, 2016; Siemens & Long, 2011).

A comparison with studies on Kazakhstan shows similar conclusions. In particular, it is noted that digitalization promotes the development of distance learning, expands access to educational resources and improves the management of the educational process (Nurtayeva et al., 2024). However, it is emphasized that its effectiveness depends on the level of infrastructure, the competencies of teachers and the willingness of universities to change.

The results of this study complement these conclusions. They show that the impact of digitalization in Kazakhstan is manifested primarily at the quantitative level through the growth of performance indicators. At the same time, the qualitative characteristics of graduate training, such as skills and compliance with labor market requirements, remain less pronounced. This indicates that the digital transformation is still primarily infrastructural in nature.

Comparison with international experience also confirms that Kazakhstan is at an intermediate stage of digital transformation. In developed countries, digital technologies are deeply integrated into the educational process, data analytics and artificial intelligence elements are actively used (Frank et al., 2019; Acemoglu & Restrepo, 2020), while in Kazakhstan the main focus is so far on the development of the technical base.

The obtained results helped to identify a number of institutional limitations. Among them is the insufficient level of digital competencies of teachers, fragmented technology adoption and weak integration of digital solutions into educational programs and quality management systems. Thus, it can be concluded that digitalization is an important but insufficient condition for improving the quality of higher education. Its effectiveness is determined not only by the availability of technologies, but also by how deeply they are embedded in the educational process.

Generally, the results of the study confirm that the development of digital infrastructure is a significant factor in improving the effectiveness of higher education in Kazakhstan. However, in order to achieve sustainable qualitative changes, it is necessary to move from a simple increase in infrastructure to a deeper institutional transformation, including updating educational programs, developing digital competencies and using analytical management tools.

6. Conclusions

The purpose of this study was to quantify the impact of digitalization on the effectiveness of the educational process in the higher education system of Kazakhstan. The analysis showed that the development of higher education in the country is taking place in the context of stable structural changes, accompanied by an increase in the number of students, optimization of the university network and the gradual expansion of the digital infrastructure. The results obtained indicate that there is a positive relationship between the level of digitalization and the performance indicators of the educational process. In particular, an increase in the provision of students with computers with Internet access is associated with an increase in the graduation rate, which is confirmed by the results of an econometric assessment.

At the same time, it has been established that the impact of digitalization at the present stage is mainly quantitative. The expansion of digital infrastructure contributes to improving access to educational resources, the development of distance and hybrid forms of learning, as well as improving the overall effectiveness of the educational process. However, these changes are not always accompanied by a corresponding increase in the quality of graduate training, their competencies, and compliance with labor market requirements.

A comparison of the results obtained with international experience allows us to conclude that Kazakhstan is at an intermediate stage of the digital transformation of higher education. Despite the achieved level of development of the technical base and the active introduction of digital solutions, institutional constraints remain related to the level of digital competencies of teachers, insufficient integration of technologies into educational programs and the limited use of analytical tools in the management of the educational process.

Thus, digitalization is an important factor in improving the effectiveness of higher education, but its potential is not fully realized. To achieve sustainable qualitative changes, it is necessary to move from a predominantly infrastructural approach to a more comprehensive transformation focused on integrating digital technologies into the content of education, developing human capital

and improving the management mechanisms of the educational system. Thus, the results of the study confirm that digitalization is one of the key directions in the development of higher education in Kazakhstan and plays an important role in adapting the system to the requirements of the modern digital economy.

Author Contributions: Conceptualization and theoretical framework, AD, MU, AN; Methodology and research design, AD, MU, AN; Software, AD; Validation, MU; Formal analysis, MU, AN; Investigation, AD, MU, AN; Resources, MU, AN; Data curation, AN; Draft writing, AD, MU, AN; Writing-review and editing, AD, AN; Visualization, AD; Supervision, MU; Project Administration, AD, MU, AN; Funding acquisition, AD, MU, AN. All authors have read and agreed to the published version of the manuscript.

References

Acemoglu, D., & Restrepo, P. (2020). Robots and jobs: Evidence from US labor markets. Journal of Political Economy, 128(6), 2188–2244. https://doi.org/10.1086/705716

Agbo, S. A., Pak, N. S., Abdrasheva, D., & Karimova, B. (2023). Modernizing Kazakhstan's higher education: Challenges of policy borrowing and Doctor of Philosophy graduation requirements. International Journal of Educational Reform, 35, 229–255. https://doi.org/10.1177/10567879231191500

Ahn, E. S., Dixon, J., & Chekmareva, L. (2018). Looking at Kazakhstan's higher education landscape: From transition to transformation between 1920 and 2015. In J. Huisman, A. Smolentseva, & I. Froumin (Eds.), 25 years of transformations of higher education systems in post-Soviet countries. Palgrave Macmillan. https://doi.org/10.1007/978-3-319-52980-6_8

Al-Dmour, R. H., Al-Dmour, H., Iskandrani, M., & Al-Dmour, A. H. (2025). The impact of digital transformation on the reputation of public higher education institutions in Jordan. SAGE Open, 15(4). https://doi.org/10.1177/21582440251390962

Asian Development Bank. (2021). Digital transformation in higher education in Asia. https://www.adb.org

Azimbayeva, G. (2017). Comparing post-Soviet changes in higher education governance in Kazakhstan, Russia and Uzbekistan. Cogent Education, 4(1), 1399968. https://doi.org/10.1080/2331186X.2017.1399968

Bayetova, N., & Robertson, D. L. (2024). Kazakhstan's nationalistic globalism: Paradox, language, and higher education. Power and Education, 17, 67–80. https://doi.org/10.1177/17577438231225126

Becker, G. S. (1993). Human capital: A theoretical and empirical analysis, with special reference to education (3rd ed.). University of Chicago Press.

Bureau of National Statistics. (2025). Bureau of National Statistics of the Republic of Kazakhstan. Retrieved January 30, 2026 from https://stat.gov.kz/en

Carmo, J. E., Lacerda, D. P., Klingenberg, C. O., & Piran, F. A. (2025). Digital transformation in the management of higher education institutions. Sustainable Futures, 9, 100692. https://doi.org/10.1016/j.sftr.2025.100692

Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox and possibility. Journal of Interactive Media in Education, 2012(3), 1–20. https://doi.org/10.5334/2012-18

Duisenova, S. M., Kylyshbaeva, B., Avsydykova, K. A., & Ishanov, Y. (2020). Sociological analysis of educational strategies in the system of higher education in Kazakhstan. Space and Culture, India, 7(4), 181–193. https://doi.org/10.20896/saci.v7i4.790

European Commission. (2022). Digital education action plan (2021–2027). https://education.ec.europa.eu

Ferguson, R. (2012). Learning analytics: Drivers, developments and challenges. International Journal of Technology Enhanced Learning, 4(5–6), 304–317. https://doi.org/10.1504/IJTEL.2012.051816

Fleischhauer, K.-J. (2007). A review of human capital theory: Microeconomics. University of St. Gallen Discussion Paper No. 2007-01. https://doi.org/10.2139/SSRN.957993

Frank, M. R., Autor, D., Bessen, J. E., Brynjolfsson, E., Cebrian, M., Deming, D. J., Feldman, M., Groh, M., Lobo, J., Moro, E., Wang, D., Youn, H., & Rahwan, I. (2019). Toward understanding the impact of artificial intelligence on labor. Proceedings of the National Academy of Sciences, 116(14), 6531–6539. https://doi.org/10.1073/pnas.1900949116

Goodman, B. A., & Kambatyrova, A. (2022). Both necessary and irrelevant: Political economy and linguistic injustice of English in higher education in Kazakhstan. International Journal of the Sociology of Language, 77–94. https://doi.org/10.1515/ijsl-2021-0074

Gorshenin, A. (2018). Toward modern educational IT-ecosystems: From learning management systems to digital platforms. 2018 International Congress on Ultra Modern Telecommunications and Control Systems, 1–5. https://doi.org/10.1109/ICUMT.2018.8631229

Hanushek, E. A., & Woessmann, L. (2008). The role of cognitive skills in economic development. Journal of Economic Literature, 46(3), 607–668. https://doi.org/10.1257/jel.46.3.607

Hartley, M., Gopaul, B., Sagintayeva, A., & Apergenova, R. (2016). Learning autonomy: Higher education reform in Kazakhstan. Higher Education, 72(3), 277–289. https://doi.org/10.1007/s10734-015-9953-z

Kireyeva, A. A. (2025). Higher education and national development: Insights from Kazakhstan's transition economy. Eurasian Journal of Economic and Business Studies, 69(2), 5–18. https://doi.org/10.47703/ejebs.v69i2.488

Lodhi, I., & Ilyassova-Schoenfeld, A. (2022). The Bologna process and its impact on higher education reforms in Kazakhstan. Studies in Higher Education, 48, 204–219. https://doi.org/10.1080/03075079.2022.2124244

Massyrova, R., Tautenbaeva, A., Tussupova, A., Zhalalova, A., & Bissenbayeva, Z. (2015). Changes in the higher education system of Kazakhstan. Procedia – Social and Behavioral Sciences, 185, 49–53. https://doi.org/10.1016/j.sbspro.2015.03.458

Narbaev, T., Amirbekova, D., & Bakdaulet, A. (2025). A decade of transformation in higher education and science in Kazakhstan. Publications, 13(3), 35. https://doi.org/10.3390/publications13030035

Nurtayeva, D. K., Kredina, A. A., Kireyeva, A. A., Satybaldin, A. A., & Ainakul, N. (2024). The role of digital technologies in higher education institutions: The case of Kazakhstan. Problems and Perspectives in Management, 22(1), 562–577. https://doi.org/10.21511/ppm.22(1).2024.45

Psacharopoulos, G., & Patrinos, H. A. (2004). Returns to investment in education: A further update. Education Economics, 12(2), 111–134. https://doi.org/10.1080/0964529042000239140

Selwyn, N. (2016). Education and technology: Key issues and debates (2nd ed.). Bloomsbury Academic.

Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. EDUCAUSE Review, 46(5), 30–40.

Zenkova, T., & Khamitova, G. (2018). English medium instruction as a way to internationalization of higher education in Kazakhstan. e-TEALS, 8, 126–158. https://doi.org/10.2478/eteals-2018-0006

Information about the authors

Aissulu Dzhanegizova – PhD candidate, al-Farabi Kazakh National University, Almaty, Kazakhstan, email: aisulu055@mail.ru, ORCID ID: https://orcid.org/0009-0000-7439-5226
Akan Nurbatsin – PhD, University of International Business named after K. Sagadiyev, Almaty, Kazakhstan, email: nurbatsin.a@uib.kz , ORCID ID: https://orcid.org/0000-0001-5390-5776
Marat Urdabayev – PhD candudate, al-Farabi Kazakh National University, Almaty, Kazakhstan, email: marat.urdabayev@ieconom.kz, ORCID ID: https://orcid.org/0000-0001-8270-6821

Авторлар туралы мәліметтер

Джанегизова А. – PhD дкоторанты, әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан, email: aisulu055@mail.ru, ORCID ID: https://orcid.org/0009-0000-7439-5226
Нурбацин А. – PhD, Қ. Сағадиев атындағы Халықаралық бизнес университеті, Алматы, Қазақстан, email: nurbatsin.a@uib.kz , ORCID ID: https://orcid.org/0000-0001-5390-5776
Урдабаеа М. – PhD докторанты, әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан, email: marat.urdabayev@ieconom.kz, ORCID ID: https://orcid.org/0000-0001-8270-6821

Сведения об авторах

Джанегизова А. – PhD дкоторант, Казахский национальный университет им. Аль-Фараби, Алматы, Казахстан, email: aisulu055@mail.ru, ORCID ID: https://orcid.org/0009-0000-7439-5226
Нурбацин А. – PhD, Университет международного бизнеса им. К. Сагадиева, Алматы, Казахстан, email: nurbatsin.a@uib.kz , ORCID ID: https://orcid.org/0000-0001-5390-5776
Урдабаеа М. – PhD докторант, Казахский национальный университет им. Аль-Фараби, Алматы, Казахстан, email: marat.urdabayev@ieconom.kz, ORCID ID: https://orcid.org/0000-0001-8270-6821