







“Formation of highly intelligent capital at the expense of government spending: Economic effect for Kazakhstan”

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FORMATION OF HIGHLY INTELLIGENT CAPITAL AT THE EXPENSE OF GOVERNMENT SPENDING: ECONOMIC EFFECT FOR KAZAKHSTAN

Abstract

Support for the education system is a strategic measure that ensures the long-term development and growth of a country's economy. Increased funding in this area enables the training of qualified specialists who can adapt to the challenges of the modern economy. In this regard, the purpose of this study is to assess the impact of government spending on education to generate highly intelligent human capital on economic growth in Kazakhstan from 2009 to 2023 using the least squares method, which includes components of government spending on education, as well as the GLS random effects model, which is used to determine the reliability of results. The results show a strong relationship between economic growth and government spending on secondary technical education (0.2393), a moderate relationship between higher education spending (0.0423) and economic development, and a weak relationship between primary education (-0.0050) and economic growth. Thus, a 1-point increase in expenditures for secondary technical education may lead to a 0.2393% increase in GRP, and a 1-point increase in government spending on higher education will lead to a 0.0423% increase in GRP. However, a significant share of government spending is on basic primary education (58%). Based on this, the financing of the education system requires a shift in the financing vector, with a greater focus on higher and secondary technical education, to achieve a more significant impact on economic development.

Keywords

government spending, education, highly intelligent human capital, economic growth, Kazakhstan

JEL Classification

H52, I25, I28

INTRODUCTION

One of the driving factors of economic development is a country's human resources. The development of human capital, which includes education and skills, is a prerequisite for creating and maintaining a knowledge-based economy. Therefore, for the development of human resources, the country needs to invest in an educational system that will train human resources to achieve the goals that entail economic development. A country's intellectual potential is formed due to the development of human resources; in this regard, the formation of human resources occurs at the expense of the educational system. The volume of the educational system shows the possibilities of education in shaping the country's intellectual potential. In this regard, the educational system is one of the main areas requiring more careful planning and high costs. In most countries, education costs comprise a significant part of the government budget. On average, OECD countries spend about 5-8% of GDP on education. For example, in Scandinavian countries such as Denmark and Sweden, spending on education can

reach about 7% of GDP (Boix, 1997). From 2013 to 2016, in these countries, the share of education expenditures as part of the total state budget ranged from 7.81% to 26.35% (Camargo & Stein, 2019). R&D expenditures in developed countries can range from 1% to 3% of GDP. For example, in 2020, R&D spending amounted to about 3% of the GDP of the United States. The cost of vocational training and retraining programs can range from 0.5% to 1% of the total budget, depending on the Government's employment policy. The financing of cultural initiatives may be a smaller share of the budget, often less than 1%, but it also depends on the priorities of a particular state (Isiaka, 2020). According to the World Bank, government spending on education in Kazakhstan varies from 3 to 5% of GDP, which is significantly lower than in other countries, as the population of about 20 million people should be considered.

The transformation of the educational system for the formation of highly intelligent human resources requires consideration of all levels of the educational system. To improve the quality of human resources, attention should be paid not only to a person's professional skills but also to their essential and secondary education. High-quality education increases the population's literacy, cognitive abilities, and professional skills, directly affecting labor productivity and a country's innovative potential. Educated people adapt faster to changes in the labor market, adopt new technologies, and promote entrepreneurship, which in the long run leads to an increase in GDP and an improvement in living standards. Thus, investments in school education are not only a social necessity but also a strategic tool for ensuring long-term economic development. In the context of the constantly changing global economic situation and growing market competition, the development of qualified personnel is crucial, and this requires a well-planned education policy, which necessitates a sufficient level of funding.

1. LITERATURE REVIEW

Human capital development is a prerequisite for achieving sustainable economic growth in the country, and many scientific papers have been devoted to studying this issue. Research by some scientists shows that regions with a high level of human capital development, where sufficient funding is allocated to education, achieve higher results in the commercialization of knowledge (Pelinescu, 2015; Wang & Liu, 2016; Dutu & Sicari, 2020; Villela & Paredes, 2022). In contrast, regions with a low education funding level have low productivity and effectiveness, which is reflected in the country's economic development (Laskowska & Dańska-Borsiak, 2016; Biela, 2021). Other researchers argue that human resources contribute to increased economic productivity and innovation, including the population's knowledge, skills, and health (Mincer, 1984; Nuta et al., 2022; Zhang et al., 2022; Jie & Lan, 2024). Moreover, technological progress plays a crucial role in the transition from stagnation to growth. Highly educated people foster technological innovation, while a lack of education in the workforce can make it challenging to develop and adopt technology. In this context, it becomes important to finance the education sector to stimulate scientific activ-

ity and innovation, which can improve economic performance (Andrews et al., 2019; Hashmat et al., 2024; Hou & Sun, 2024). However, to form highly intelligent human resources, it is necessary to look more deeply at the formation and development environment of human capital in the country, which creates the importance of paying attention to basic (primary and general education) education (Gueye, 2022; Kangalakova et al., 2023). Basic education plays a key role in the formation of highly intelligent capital. It provides fundamental skills for comprehending knowledge and producing products of mental activity (Degryse, 2016; Zhang et al., 2022; Rossi et al., 2024). Secondary education allows students to study various subjects in depth, which contributes to the development of specialized knowledge and skills necessary for further education and professional activity (Kireyeva, et al., 2022). Higher education prepares students for specific professions, providing them with the necessary skills and knowledge for a successful career (Tosic & Zivkovic, 2019; Doshmanova et al., 2024). It promotes professional and personal growth, developing students' self-confidence, independence, and the ability to self-study. Postgraduate education (master's degree, postgraduate, and other study forms) is important in forming highly intellectual capital. This education allows students to

deepen their knowledge in a specific field, contributing to the formation of highly qualified experts. Also, postgraduate education often encourages innovative thinking and an entrepreneurial approach, which contributes to creating new start-ups and businesses.

Different countries have different experiences in the formation of highly intelligent human capital. For example, Singapore invests heavily in education starting early (Olawajun & Msomi, 2021). Finland is famous for its educational system, which focuses on equality, individual approach, and high professional teacher training (Chen & Fleisher, 1996; Poutanen, 2023). On the other hand, Sweden allocates significant funds to research and development, which contributes to creating a highly skilled workforce (Fryer, 2016). South Korea focuses on science, technology, engineering, and mathematics (STEM), which contributes to the training of highly qualified specialists in these fields. The country actively invests in new technologies and start-ups, creating a dynamic economy and high employment opportunities. These countries demonstrate that investments in education, professional development and innovation are key factors in the formation of highly intelligent human capital, which, in turn, contributes to economic growth and competitiveness on the global stage. As mentioned earlier, public investment in education can lead to regression or setback in the economy's structure. According to research by scientists, during the transition to knowledge-intensive areas of economic development, funds are often injected into unprofitable and inefficient sectors of the economy (Budhathoki, 2022; Chen et al., 2022; Phuyel et al., 2024). Corruption and misuse of funds: in conditions of insufficient transparency and weak institutions, public investments can be susceptible to corruption (Sawyer et al., 2017). Thus, public investments can become both a catalyst and a brake on economic development in a transitional economy, depending on how they are managed and directed.

Digitalization is another important point in the development of education and its impact on the economy. Digitalization plays a key role in forming human capital, especially in the context of modern changes associated with the Fourth Industrial Revolution (Industry 4.0) (Adilkhanov

& Sabden, 2021; Hetmańczyk, 2024; Kurian, 2025). Digitalization provides new opportunities for training and professional development of employees (Ammirato et al., 2023; Benjilali et al., 2024; Pea-Assounga & Bindel Sibassaha, 2024). Online learning platforms, virtual trainings and simulations allow employees to develop the necessary skills in a format that is convenient for them, which contributes to the formation of more qualified and adaptive human capital (Piwowar-Sulej et al., 2024).

In rapid technological progress, employees must be prepared for changes. Digitalization helps to develop flexibility and adaptability, an important aspect of human capital in the modern world (Letiagina et al., 2019). It also helps to create an environment in which innovative thinking and creativity are encouraged. This is important for forming human capital to generate new ideas and solutions. Thus, digitalization transforms human resource management processes and contributes to creating more competitive and sustainable human capital, ready for the challenges of the modern world. Thus, education plays a hugely important role in the formation of highly intelligent human resources, which will affect the creation of economic benefits that will compete in the global market, leading to a more competitive and innovative economy.

Therefore, this study aims to identify the main growth points of knowledgeable human resources through an empirical analysis of the impact of government spending on education and its relationship to economic growth.

2. METHOD

This analysis employed a mathematical and econometric approach to examine the impact of government spending on education and its effect on economic development. Statistical data were taken from the database of the Bureau of National Statistics of the Agency of the Republic of Kazakhstan for Strategic Planning and Reforms. The data set includes 252 observations for 2 to 15 years, depending on the data availability for each region in 20 regions of Kazakhstan. The model was evaluated using the combined simple least

squares (OLS) method. This method was also used by researchers, which shows the knowledge of the results and a clear link between economic growth and education (Mekdad et al., 2014; Khalfaoui & Derbali, 2020; Ramli et al., 2022). In addition, the random Effects GLS model was also used to improve the reliability of the research results, and the results of the two were compared. This study employed a model to assess the impact of government spending on education in a country on its economic growth (GDP). This equation defines the relationship between education costs, human capital, and economic development and looks like this:

$$GDP_{it} = \beta_0 + \beta_1 ExpBSE_{it} + \beta_2 ExpCol_{it} + \beta_3 ExpHPE_{it} + \varepsilon_{it}, \quad (1)$$

where i – spatial object (regions); t – time period, year; GDP_{it} – dependent variable (gross domestic product); $ExpBSE$ – expenses for basic and Secondary Education, tenge; $ExpCol$ – college-level education costs, tenge; $ExpHPE$ – costs for higher and postgraduate education; ε_{it} – error.

The statistical analysis was conducted using software capable of processing panel data models, which is presented in Table 1. The following are descriptive statistics, regression results, and diagnostic studies. To ensure the reliability of the results, White’s heteroscedastic test, the formula of which is given below, was performed as a diagnostic test.

Diagnostic test. White test formula:

Basic regression model:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + u_i, \quad (2)$$

where Y_i – dependent variable; $X_{1i}, X_{2i}, \dots, X_{ki}$ – independent variables, $\beta_0, \beta_1, \beta_2, \dots, \beta_k$ – coefficients of the model, u_i – errors. Regression of the square of the residues:

$$u_i^2 = \gamma_0 + \gamma_1 Z_{1i} + \gamma_2 Z_{2i} + \dots + \gamma_m Z_{mi} + e_i, \quad (3)$$

where $Z_{1i}, Z_{2i}, \dots, Z_{mi}$ – new combinations of the original independent variables (or their squares, cross-production), $\gamma_0, \gamma_1, \gamma_2, \dots, \gamma_m$ – new regression coefficients, and $-e_i$ errors of the new regression. Main statistics of the White test – nR^2 :

$$nR^2 \sim \chi_{m2}, \quad (4)$$

where n is the control number, R^2 is the R-Square value of the additional regression, χ_{m2} is the Chi-square division, and m is the number of additional variables.

Suppose the value of nR^2 is greater than the critical value of the Chi-square division. In that case, the null hypothesis (no heteroskedasticity) is rejected, and the model is assumed to have heteroskedasticity.

3. RESULTS AND DISCUSSION

Compared to foreign countries, Kazakhstan’s share of education expenditures is insignificant. Considering the population size and GDP value, the cost of education is relatively small. In 2019, spending on education accounted for 3.5% of GDP, and by 2023, this had increased to 4.6%. This is a positive trend reflecting the increased priority of education in the state budget. Additionally, the table 2 displays the share of funding allocated to education levels within the total government expenditure on education. A significant share of government spending on education is allocated to primary and basic education, accounting for approximately 57.8% in 2023. This is followed by higher and postgraduate education, which accounts for 13.3% of the total funding, representing a decrease from 2019, when this level of education accounted for 17.5%. The lowest funding is for secondary specialized and technical education, which accounts for 6.6% of the total education funding. This is

Table 1. Variables

No.	Variables	Name of the Variables	Source
1	GDP	GDP	Bureau of national statistics Agency for strategic planning and reforms of the Republic of Kazakhstan (n.d.)
2	ExpBSE	Expenditure on basic secondary education	
3	ExpCol	Expenses for colleges	
4	ExpHPE	Expenses for higher and postgraduate education	

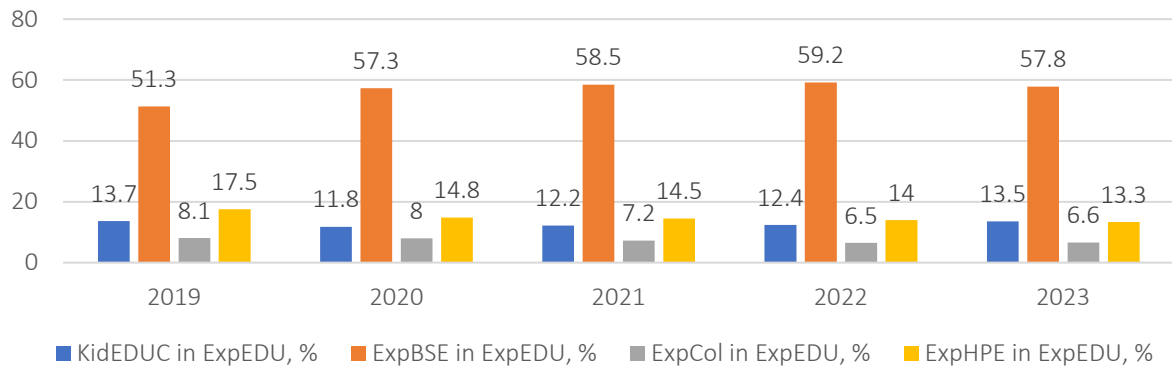


Figure 1. Distribution of education costs by levels

Table 2. Dynamics of government spending on education levels, %

Year	ExpEDU in GDP, %	KidEDUC in ExpEDU, %	ExpBSE in ExpEDU, %	ExpCol in ExpEDU, %	ExpHPE in ExpEDU, %
2019	3.5	13.7	51.3	8.1	17.5
2020	4.1	11.8	57.3	8.0	14.8
2021	4.5	12.2	58.5	7.2	14.5
2022	4.4	12.4	59.2	6.5	14.0
2023	4.6	13.5	57.8	6.6	13.3

an alarming signal, especially in the context of the need for an intermediate professional level in Kazakhstan’s economy, as the country seeks to move beyond its status as a donor of raw materials. Preschool education accounts for 13.5% of total expenses.

Clear dynamics of the distribution of education costs by level can be seen in Figure 1. The priority remains for basic and secondary education, as the majority of funding is allocated to this level. The financing of higher education exhibits a negative trend, which may ultimately weaken the training of highly qualified personnel. Secondary technical education is poorly funded; however, in Kazakhstan, the necessary personnel are trained at this level of education. Thus, it is essential to balance investments in basic, higher, and vocational education to provide the economy with the

necessary personnel.

Furthermore, according to the methodology, an econometric analysis was conducted. The ratio of primary and secondary education costs is negative but not statistically significant at 5% ($P=0.094$). This means that public spending on primary and secondary education had a weak impact on GDP during the controlled period. It can be characterized by the fact that the state’s spending on secondary education does not affect economic growth (Table 3).

The results can be highlighted by the research of (Barro, 1999), which examines the impact of primary education and, in more detail, the impact of assessment from a gender perspective. Based on this, primary education has a comparatively low value in the economic development effect. The ra-

Table 3. Results of the OLS model evaluation for the dependent variable (GDP)

OLS Model		Dependent Variable GDP		
Independent Variable	Coefficient	Std. Error	t-Statistic	P-Value
Constant	279,594.38	207,415.66	1.348	0.179
ExpBSE	-0.0050	0.00299	-1.681	0.094 *
ExpCol	0.2393	0.03185	7.512	1.05×10 ⁻¹² ***
ExpHPE	0.0423	0.00343	12.329	1.47×10 ⁻²⁷ ***

Note: Instrument Gretl, Observations 252, R-squared 0.719; *p < 0.10, ** p < 0.05, *** p < 0.01

tio of spending on education in colleges is positive and very significant (< 0.01). The increase in college education costs by one unit is associated with an increase in GDP by 0.2393, which indicates a significant contribution of this level of education to economic growth. In Kazakhstan, the relationship between colleges and businesses has reached a new level and contributed to economic growth by training working specialists in various sectors of the economy based on state support. As everyone knows, Kazakhstan has a high potential for extracting raw materials. However, there are not enough specialists to turn this potential into a finished product. The development of educational programs for specialists in secondary technical education is vital for Kazakhstan and can lead to economic development. In addition, the ratio of costs for higher and postgraduate education is also positive and statistically significant (< 0.01). For each additional unit of expenditure in this category, A GDP growth of 0.0423 is likely, which indicates the importance of advanced education to increase economic productivity. In this case, the results of many scientists emphasize the positive relationship and importance of higher education development about economic development (Gyimah-Brempong et al., 2006). In the scientific community, African countries are particularly singled out for trying to stimulate economic development by developing higher education by allocating more funding (Appiah & McMahon, 2002; Ojima & Anyanwu, 2021).

The results of the model are adequate. The adjusted R^2 equals 0.71658, which indicates that the model explains about 71.66% of the GDP variance. The high value of the F-statistic and the associated significance level (< 0.01) confirm the model's overall validity. The results of this study, conducted on the example of Kazakhstan, showed that education costs at different levels had different effects on economic growth. Spending (investments) on colleges and higher education showed a strong correlation with GDP, highlighting the important role of higher education in economic development. Although the direct impact of secondary education costs is small, they can contribute to the long-term formation of human capital, which requires additional research.

Future research should examine the possible ef-

fects of delays and explore regional differences to better understand the dynamics of the impact of education costs on economic indicators.

4. DIAGNOSTIC TESTS

White's test for heteroskedasticity was conducted to evaluate the presence of variance instability in the model. The test yielded the following results:

Degrees of freedom: 9; Test statistic: 7.42; P-value: 0.593.

The test indicates no evidence of heteroskedasticity, supporting the validity of the pooled OLS estimates.

In this study, the results of the White test show that the null hypothesis (no heteroscedasticity) is accepted because the P designation is greater than 0.05. This means that the variance of the model's residues is constant, and there is no heteroscedasticity in the model.

In Table 4, Column (Pooled OLS), the ratio of costs for primary and secondary education is not statistically significant ($p = 0.9046$); that is, this indicator does not affect the volume of regional products. And the cost of colleges also showed statistical significance in this model ($p = 0.001$). This indicator impacts the volume of regional products; that is, an increase in spending on colleges by 1 point leads to an increase in GRP by 0.2649%. Higher and postgraduate education costs also turned out to be statistically significant ($p = 0.001$). An increase in this factor by 1 point will contribute to an increase in GRP in the regions by 0.0373%. The Random Effects GLS model can be viewed as adequate, $R^2 = 0.708$. The Random Effects GLS model considers the data structure and each region's specific features. In addition to secondary education, we have seen that two factors directly impact economic growth. Therefore, reforming education and increasing funding should be an important part of regional economic development strategies. In Table 4, Column (Random Effects GLS), the two models used in this study are compared.

In both models in Table 4, the cost ratios for colleges and higher and postgraduate education are

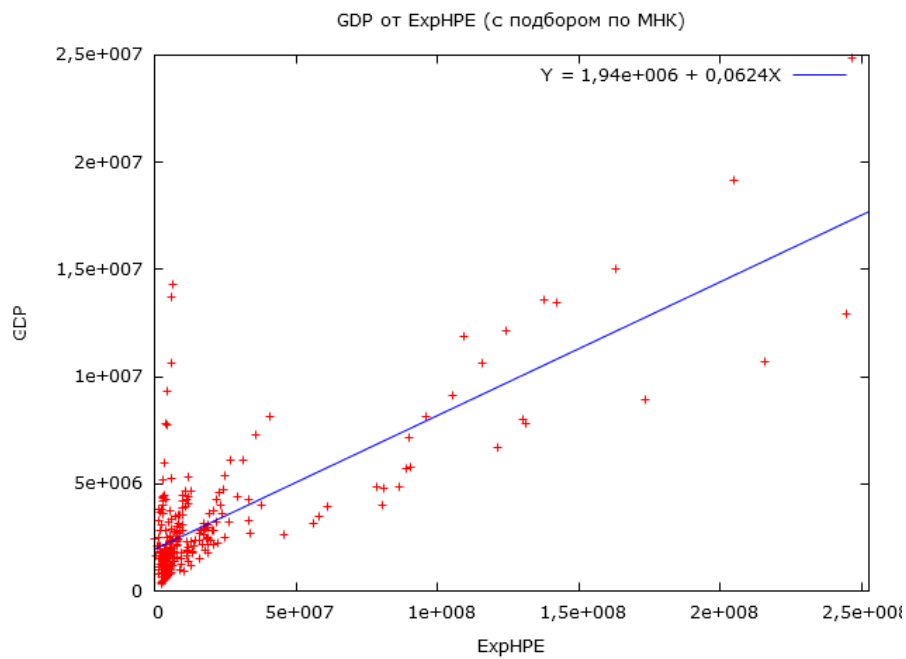


Figure 2. Regression equation

Table 4. Results of the Random Effects GLS Model evaluation

Indicator	Pooled OLS	Random Effects GLS
Const	279,594 (p = 0.1789)	-348,806 (p = 0.2954)
ExpBSE	-0.0050 (p = 0.0941)*	-0.0003 (p = 0.9046)
ExpColl	0.2393 (p < 0.001)***	0.2650 (p < 0.001)***
ExpHPE	0.0423 (p < 0.001)***	0.0373 (p < 0.001)***
R ²	0.720	0.708
R ² Corrected	0.717	NA
The Akaike information criterion (AIC)	7947.729	7962.231
Schwarz information criterion (SIC)	7961.847	7976.348
Test statistics (F)	212.54 (p < 0.001)	Chi-square (3) = 1072.02 (p < 0.001)
Breusch-Pagan Test	NA	Chi-square (1) = 742.22 (p < 0.001)
Hausman Test	Chi-square (3) = 7.42 (p = 0.0598)	NA

Note: p < 0.001: very important (***); p < 0.1: weakly important (*); NA: unavailable or unacceptable metric.

important (p < 0.001). And the cost of Secondary Education is only slightly significant in the Pooled OLS model (p < 0.1). Regarding Model quality, Pooled OLS R² is superior (0.719), but Random Effects considers heteroscedasticity and correlation in the GLS data structure, so its results may be more reliable. The Hausman Test (p = 0.0598) allows you to use the random Effects GLS model. Also, based on the above Ordinary Least Squares (OLS) model, a regression equation was given to each indicator using individual graph results.

Figure 2 shows the relationship between college spending and economic growth using a linear

regression model selected using the least squares method (MNC). Based on statistics from 20 regions of Kazakhstan, spending on colleges positively impacts economic growth. This means that as spending on colleges increases, so does the GRP value. The regression line calculated using the MNK method fits well with the data points and allows you to see this relationship more clearly. Regression line equation: $Y = -3.44 e + 05 + 0.355 X$. Spending on colleges significantly impacts economic growth. These costs increase the professional skills of young people and improve regional labor markets, and as a result, contribute to the growth of gross domestic product.

CONCLUSION

The purpose of this study is to examine the key growth points contributing to the training of qualified personnel, with an emphasis on the impact of government funding on educational levels. The study examined the effect of education levels on changes in a country's economic development. Based on the study's results, Kazakhstan should give priority attention to the development of secondary technical education. According to calculations, a 1-point increase in government spending on secondary technical education leads to a 0.2393% increase in GRP, and a 1-point increase in spending on higher education leads to a 0.0423% increase in GRP. Kazakhstan, with its vast natural resources, lacks the human resources required to produce finished products. In addition, due to the attraction of foreign technologies, it lacks personnel who could work with machines and tools to create technology that allows it to produce finished products. Thus, it is possible to increase state funding for secondary technical and vocational education, which will ensure staff training and lead to improved economic development. The following conclusion applies to higher education; financing this level of education is also an economically beneficial investment in the training of highly qualified personnel, which can lead to the innovative development of Kazakhstan. An interesting fact is that significant government investments are being made in basic education. However, this study reveals a negative impact, indicating a detrimental effect on economic development. Thus, to ensure long-term, sustainable economic growth, Kazakhstan needs to review its state education strategy, shifting the focus from excessive financing of primary and basic education to the development and financial support of secondary technical and higher education. In addition to increasing funding, it is necessary to introduce incentive measures to improve the quality of education, expand practice-oriented programs, and encourage closer cooperation between educational institutions and the real sector of the economy. All this will contribute to the training of qualified personnel and the development of highly intelligent human capital, which will become a powerful engine for the country's future economic growth.

AUTHOR CONTRIBUTIONS

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Writing – original draft: Sharbanu Turdalina, Zaira Satpayeva, Dinara Mukhiyayeva.

Writing – review & editing: Dinara Mukhiyayeva, Sharbanu Turdalina, Zaira Satpayeva.

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