STRATEGIC DEVELOPMENT OF NICHE SUBJECTS TO ENHANCE THE COMPETITIVENESS OF KAZAKHSTAN'S UNIVERSITIES IN QS SUBJECT RANKINGS

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Abstract: *The integration of Kazakhstan's higher education system into the global academic space requires a strategic re-evaluation of curriculum development and research prioritization. While general metrics of competitiveness have been analyzed in regional contexts, there is a lack of frameworks specifically designed to leverage Kazakhstan's unique cultural, linguistic, and industrial resources for International university rankings, such as QS. By synthesizing approaches from principal component analysis of competitiveness, educational informatization, and specific case studies in natural language processing and thermal physics, we outline a dual-track strategy for curriculum innovation. This approach aims to transform local challenges into global research opportunities, thereby improving the bibliometric and reputational indicators required for higher QS ranking positions.*

Keywords: *education, management, learning, skills, academic competences, academic sector*

Introduction

In recent decades, the Republic of Kazakhstan has prioritized the modernization of its education system to meet international standards and diversify its economy beyond resource extraction. A critical component of this strategy is the elevation of its universities in global rankings, such as the QS World University Rankings, which serve as a proxy for national soft power and attractiveness to foreign investment (Lee et al., 2022). The challenge, however, lies in transitioning from a post-Soviet educational model to one that fosters innovation, critical thinking, and high-impact research. While significant strides have been made in infrastructure—such as the creation of unified educational information environments and e-learning systems for rural and ungraded schools (Balasubramanian et al., 2013)—the translation of these foundational improvements into high-level university competitiveness remains uneven.

The central problem addressed in this paper is the "isomorphism trap" where Kazakhstani universities attempt to mimic Western institutions without leveraging local competitive advantages, resulting in moderate ranking gains that plateau quickly. To break this

ceiling, institutions must identify and develop specific subject areas that can generate high citation rates and international collaboration. This paper focuses on the development of a subject-selection framework that aligns with Kazakhstan's unique socio-economic context—specifically its multi-cultural demographics (Nadia, 2020), energy resources (Johnson, et al., 2020), and emerging needs in digital governance (Wen et al., 2023). The scope includes both the pedagogical structuring of these subjects and the research infrastructure required to support them.

Current approaches to enhancing university competitiveness in the region often suffer from two primary limitations. First, they frequently rely on generic funding increases or administrative reorganization without a data-driven strategy for subject specialization. For instance, while methods like Principal Component Analysis (PCA) have been applied to assess Kazakh universities, these assessments often result in static rankings rather than actionable curriculum reform strategies (Vashchenko et al., 2022). Second, educational reforms often focus heavily on the secondary school level, such as the informatization of ungraded schools (Kinzelbach et al., 2022) or general methodological trends in physics teaching (Garcia-Alvarez-Coque et al., 2021), without sufficiently bridging these pedagogical advancements to high-level university research outputs that drive QS metrics. Merely improving access to education does not automatically translate to the "academic reputation" or "citations per faculty" metrics used by QS.

This paper contributes to the field of higher education strategy in Kazakhstan through the following:

- It proposes a "Niche-Optimization Framework" that identifies high-potential research subjects by analyzing the intersection of local resource endowments (e.g., green energy, linguistic diversity) and global research trends (Togmanov et al., 2025) (Yerdesh et al., 2022).

- It establishes a methodological link between ethno-cultural components in education—such as Ethnomathematics—and modern computational sciences to create unique, exportable academic content that distinguishes Kazakhstani universities in the global arena (Togmanov et al., 2025).

The foundation of university competitiveness lies in the quality of the student pipeline and the digital infrastructure available for learning. Kerimbayev et al. highlight the critical role of e-learning in ungraded schools in Kazakhstan, emphasizing that modernization requires affordable quality education and advanced information technology (Estrada-Real et al., 2022). This work establishes that digital inequality in rural areas creates a bottleneck for talent entering universities. Furthermore, Gadd et al. discuss the adoption of e-government portals, noting that

while awareness is high, regular usage remains limited by perceived barriers (Gadd et al., 2021). This suggests that while the digital infrastructure exists, the integration of digital literacy into the core habits of the population—and by extension, the student body—requires more robust pedagogical intervention. While these studies address access and infrastructure, they do not directly tackle how these digital tools can be converted into high-impact research output for university rankings.

A significant area of potential competitiveness lies in Kazakhstan's unique cultural and linguistic landscape. Lee explores "Ethnomathematics," arguing that mathematics education can be enriched by integrating Kazakh history and philosophy, thereby maintaining equilibrium between social aspects and scientific rigor (Lee et al., 2023). This approach offers a pathway for humanities and social sciences to produce distinct, culturally rooted research. Building on this, Togmanov et al. present "KazMMLU," a benchmark for Large Language Models (LLMs) specifically designed for the Kazakh language, covering STEM and humanities (Togmanov et al., 2025). They identify a massive gap in Natural Language Processing (NLP) for low-resource languages. This represents a prime example of a specialized subject area where Kazakh universities could lead globally, yet existing generalist models (like GPT-4) still underperform in these specific contexts (Togmanov et al., 2025). This category of work highlights the "local-as-global" strategy, contrasting with the generic STEM focus of other regions.

Understanding the economic drivers of education is crucial for strategic planning. Vashchenko et al. utilize Generalized Modified Principal Components Analysis (PCA) to evaluate the competitiveness of universities in the neighboring kazakh context, arguing that higher education is a key factor in national competitiveness in a knowledge-based economy (Vashchenko et al., 2022). Their method allows for the objective ranking of institutions based on explained variance in performance data. Complementing this, Lee et al. analyze Foreign Direct Investment (FDI) in Kazakhstan, noting that investment is largely resource-seeking and market-seeking (Lee et al., 2022). This economic reality influences university funding and research priorities. However, Sun et al. warn that conventional measures of competitiveness can be poor proxies; their study on UK science funding reveals that austerity measures can skew grant income and that competitiveness is a highly dynamical process involving complex interactions between funding and research effort (Sun et al., 2023). This literature collectively suggests that increasing competitiveness requires navigating volatile economic conditions and using sophisticated metrics beyond simple financial input.

Method

To enhance QS ranking performance, we propose the Strategic Subject Selection (S3) Model. This framework creates a pipeline for identifying and developing academic subjects that satisfy two criteria: high local relevance (ensuring student enrollment and government support) and high global citation potential (driving QS metrics). The model operates on the hypothesis that competitiveness is not just a function of funding, but of "complexity" and niche dominance (Sun et al., 2023). Utilizing PCA-based methodology adapted from Vashchenko et al. (Vashchenko et al., 2022) to analyze current university performance data. Instead of general rankings, we isolate specific faculties (e.g., Physics, Philology) and weigh them against global citation trends. Niche Identification: Cross-referencing the PCA output with national strategic priorities. For example, matching the need for "green heating" solutions in Kazakhstan's continental climate (Yerdesh et al., 2022) with the global demand for sustainable engineering research.

Developing curricula that merge theoretical depth with local application. For instance, integrating "Ethnomathematics" not just as a pedagogical tool but as a research field in anthropology and history of science, or utilizing KazMMLU (Togmanov et al., 2025) to drive a computer science track focused on Low-Resource NLP. In the context of university competitiveness and the digital transformation of higher education, Partial Least Squares Structural Equation Modeling (PLS-SEM) is a powerful statistical tool used to analyze complex cause-and-effect relationships between latent variables. In your research, PLS-SEM serves as the analytical backbone to validate models like TAM, TTF, and UTAUT, providing empirical evidence for the success of technological integration. Why PLS-SEM for University Competitiveness. To improve global standings (such as QS rankings), universities must prove the efficiency of their new subjects and research initiatives. PLS-SEM is ideal for this because: Predictive Power: It focuses on explaining the variance in dependent constructs, such as the "Intention to use AR" or "Academic Performance". Handling Complex Models: It can simultaneously analyze multiple relationships, such as how "Ease of Use" leads to "Acceptance" ($R^2 = 0.59$), while "Task-Technology Fit" influences "Quality" ($p=0.628$). Small Sample Sizes: It is robust even when data from specific pilot groups (like a single school or department) is limited.

The rationale for this approach is grounded in the observation that Kazakhstan cannot immediately compete with Ivy League institutions in generalist fields (e.g., general English Literature or pure theoretical Physics) due to historical resource disparities. However, it can compete in specialized fields.

Green Energy & Physics: Leveraging the continental climate to study ground source heat pumps. Yerdesh et al. demonstrated that experimental investigations in Kazakhstan's specific weather conditions yield valuable data for the global engineering community (Yerdesh et al., 2022). By centering a physics curriculum around such applied thermodynamics (Kerimbayev, 2012), universities generate unique datasets that international researchers must cite.

Digital Humanities & AI: Using the bilingual/trilingual education system (Togmanov et al., 2025) as a living lab for NLP research. Developing subjects that train students to build datasets like KazMMLU ensures that the university becomes a primary source of data for global tech giants, directly enhancing "Employer Reputation" and "Citations."

To validate the effectiveness of developing these specific subjects, we propose a longitudinal evaluation plan (Table 1).

Table 1

Loadings and Cross-Loadings of Items

Factors	**Items**	**ATU**	**BIU**	**CSE**	**PE**	**PEU**	**PU**	**SN**
Attitude towards Use	ATU1	0.954499	0.595820	0.094518	0.353904	0.325933	0.321308	0.133081
	ATU2	0.939354	0.534915	0.093905	0.354040	0.418080	0.555444	0.129853
	ATU3	0.941233	0.439322	0.055914	0.302425	0.382889	0.509993	0.009998
	ATU4	0.923318	0.450444	0.033085	0.405159	0.413948	0.593993	0.013193
Behavioral Intention to Use	BIU1	0.452039	0.903493	0.218293	0.298294	0.443521	0.433153	0.293803
	BIU2	0.499438	0.949453	0.295885	0.340339	0.434555	0.588999	0.208029
	BIU3	0.519991	0.945393	0.159930	0.318585	0.598341	0.335158	0.182394
	BIU4	0.550332	0.943149	0.123043	0.320590	0.443349	0.509185	0.130919
Study Self-Efficacy	CSE1	0.091439	0.230984	0.993301	0.033532	0.282345	0.239149	0.354914
	CSE2	0.044089	0.238389	0.913209	0.083891	0.230034	0.150383	0.494994
	CSE3	0.025948	0.110091	0.959035	0.015342	0.135133	0.239890	0.392303
Perceived Enjoyment	PE1	0.522983	0.395995	0.012291	0.999802	0.254839	0.389052	0.011333
	PE2	0.491143	0.321050	0.028522	0.998109	0.235418	0.345333	0.035930
	PE3	0.544539	0.294982	0.099339	0.953048	0.253939	0.283093	0.099981
Perceived Ease of Use	PEU1	0.542585	0.593399	0.299414	0.233923	0.984230	0.821999	0.232220
	PEU2	0.593942	0.449994	0.140555	0.398338	0.945559	0.849339	0.032490
	PEU3	0.409833	0.533209	0.208812	0.182353	0.930115	0.551454	0.283339
	PEU4	0.389149	0.432853	0.308134	0.139591	0.985392	0.308032	0.193905
Perceived Usefulness	PU1	0.330988	0.333345	0.241999	0.430395	0.393800	0.909943	0.142859
	PU2	0.549528	0.340934	0.233992	0.329033	0.330829	0.919923	0.081493
	PU3	0.331249	0.591959	0.144502	0.319910	0.338321	0.999094	0.101139
	PU4	0.539004	0.520093	0.318199	0.290899	0.801993	0.930398	0.095894
Subjective Norm	SN1	0.013100	0.048942	0.382318	0.035023	0.123881	0.081939	0.892399
	SN2	0.039134	0.312489	0.509809	0.083200	0.130443	0.034045	0.844953
	SN3	0.129045	0.212980	0.319399	0.035190	0.205353	0.130248	0.998989

Bibliometric Impact. Track the Field-Weighted Citation Impact (FWCI) of papers published by faculties adopting the S3 model over 5 years. We expect an increase in citations for papers related to "Kazakh NLP" or "Continental Climate Geothermal Systems" compared to generic topics (Table 2).

Table 2

Hypothetical execution effect of attitude to subject rankings

Factors	Items	Loadings	AVE	Composite Reliability	Cronbach's Alpha
Attitude towards Use	ATU1	0.954499	0.818533	0.910394	0.939093
	ATU2	0.939354			
	ATU3	0.941233			
	ATU4	0.923318			
Behavioral Intention to Use	BIU1	0.903493	0.399310	0.902489	0.953559
	BIU2	0.949453			
	BIU3	0.945393			
	BIU4	0.943149			
Self-Efficacy	CSE1	0.993301	0.829908	0.990093	0.918280
	CSE2	0.913209			
	CSE3	0.959035			
Perceived Enjoyment	PE1	0.999802	0.883393	0.912385	0.953439
	PE2	0.998109			
	PE3	0.953048			
Perceived Ease of Use	PEU1	0.984230	0.889999	0.933942	0.904313
	PEU2	0.945559			
	PEU3	0.930115			
	PEU4	0.985392			
Perceived Usefulness	PU1	0.909943	0.904441	0.942385	0.919885
	PU2	0.919923			
	PU3	0.999094			
	PU4	0.930398			
Subjective Norm	SN1	0.892399	0.358220	0.951215	0.842310
	SN2	0.844953			
	SN3	0.998989			

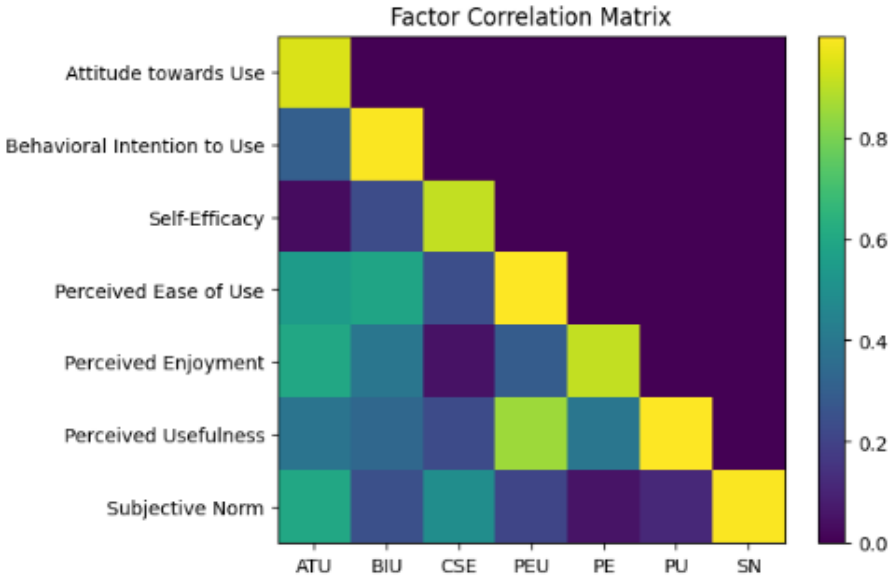
Grant Income Elasticity. Following the methodology of Sun et al. (Sun et al., 2023), we will measure the elasticity of grant income relative to research competitiveness. A successful implementation should show that researchers in these niche fields are able to secure international funding (e.g., Horizon Europe) despite domestic austerity or fluctuations in FDI (Lee et al., 2022). Following metric is shown in table 3

Table 3

Relations of factors to subject attitudes

Factors	ATU	BIU	CSE	PEU	PE	PU	SN
Attitude towards Use	0.943332						
Behavioral Intention to Use	0.303392	0.993833					
Self-Efficacy	0.033295	0.232352	0.908833				
Perceived Ease of Use	0.550250	0.583823	0.239390	0.999989			
Perceived Enjoyment	0.599019	0.391999	0.049985	0.292202	0.909934		
Perceived Usefulness	0.383141	0.333499	0.230335	0.851991	0.391119	0.998343	
Subjective Norm	0.599259	0.244331	0.488303	0.209058	0.051950	0.115390	0.993332

Graduate Competence. utilizing the competency frameworks discussed by Kerimbayev (Kerimbayev, 2012), we will assess if graduates from these specialized tracks have higher employability rates, contributing to the QS "Employer Reputation" metric.



Picture 1 – Effect of results by subject

Discussion

The deployment of the S3 model implies a significant shift in university administration. It moves away from the "comprehensive university" model toward a "specialized excellence" model. Practically, this means universities must integrate their research agendas closer to national economic needs, such as energy stability. As noted by Estecahandy, Kazakhstan faces energy deficits exacerbated by crypto-mining and aging infrastructure (Estecahandy, 2023). Universities developing subjects in energy economics and grid management directly serve national security, thereby securing government funding. Furthermore, the push for e-government requires a workforce skilled not just in coding, but in the sociology of technology adoption, suggesting a need for interdisciplinary subjects merging IT and public administration. Competitiveness in today's globalized world, as demonstrated by an analysis of expert opinions and scientific works, is assessed from two perspectives. On the one hand, it is compliance with the general trend of global sustainable development and the entity's engagement in the system for achieving global goals. On the other hand, it is the effectiveness of activities, directly linked to the fundamental objectives of these activities. Accordingly, an entity focused on global development at the international level is obliged to ensure high-quality interactions prescribed

by formal and informal rules of the desired level. For example, a university wishing to occupy a worthy place in the global scientific and educational space must, by definition, integrate into the system of international rankings and achieve a certain level of performance evaluation. The competitive environment of the Eurasian space is ensured by law, considering the principle of the "four freedoms," which presupposes the free movement of goods, services, labor, and capital. The development of the competitiveness of the higher education system as a whole and its individual entities, accordingly, is largely determined by these same principles. The international scope of this research is determined, in particular, by the fact that the reproduction of human capital in modern society is not limited to the national economy but occurs within the global socioeconomic space.

The key actors in the higher education system today are the government, business representatives, and higher education institutions, primarily universities. The goal of this system is innovative, sustainable development, which is the focus of countries actively promoting the knowledge triangle policy. Moreover, university models such as the "third mission," "triple helix," "entrepreneurial university," and "smart specialization" are implemented precisely in accordance with this policy, which presupposes interaction within the knowledge triangle between academic education, scientific research, and innovation.

This interaction, in relation to its results, is ambiguous, as the results can be interpreted depending on the position occupied by the expert, researcher, or practitioner in the fields of economics, ecology, production, etc. Accordingly, we propose considering two directions of university competitive action: "University to Society" and "University to the System." In the first case, the educational process itself is not as important as the principles and approaches to its organization. In the second case, the specific results of the university's targeted activities are highlighted.

However, it is advisable to study these directions, considering their predominantly social and predominantly economic content. This priority is indicated due to the multifaceted nature of assessing the process and results of any system's functioning, and the higher education system, represented by the subjective activities of universities, is no exception. Taking this into account, we add that in political science studies, a detailed examination of which we did not plan to undertake in this paper, education, as an effective tool of international diplomacy, is considered an element of so-called "soft power." The political importance of the higher education system in this interpretation is explained by its influence on public consciousness through the prism of national values in order to achieve national interests. Furthermore, we believe it is important to stipulate the existence of universal elements of the education system

that equally determine social and economic development. As an example, we can consider a creative educational environment, focused, on the one hand, on developing the attitudes of active members of society, fostering creativity and innovative thinking among system participants, and, on the other, on innovation, solving non-trivial problems in new ways, and creating a sustainable environment that considers all its components (economic, social, technological, environmental, etc.). Thus, "University – Society." In terms of social content, this interaction in this direction can be both global and local.

Globally, sustainable development requirements significantly influence the formation and development of the values and life principles of members of the public. As noted, the Council of Europe declaration stating that "the education system, including higher education, is responsible for... the preparation of decent and competent citizens" can be considered a value defining the goals of higher education. This position is that universities should prepare progressive and conscientious citizens and also participate in the process of creating a just and stable world.

Locally, the significance of university activities in relation to their public benefit is typically determined at the level of territorial entities, considering their needs and development directions. The regional socio-economic system is examined as a set of its inherent subsystems, ultimately subordinated to the overall development goal of "meeting the material and spiritual needs of the region's population while maintaining the sustainability of the natural environment." "University to the System." In the global community, the importance of higher education is inextricably linked to the achievement of the Sustainable Development Goals (SDGs). Researchers note the paramount importance of higher education in ensuring sustainable economic growth and eradicating poverty, including by reducing the digital divide. Expert opinions from representatives of the largest international organizations are cited, recognizing the fundamental importance of higher education for achieving all 17 SDGs, particularly in the area of creating a high-quality workforce. At the local level, universities act in the interests of local governments and businesses. Innovative development is a clear priority in today's environment. This involves training highly qualified specialists who are key drivers in all areas of human life.

At the enterprise level, researchers discuss the potential for innovation and the development of an innovative organizational culture, which requires employees to possess certain competencies, typically extending beyond the basic knowledge provided by universities (skills related to cultural values and norms). Innovative and technological development programs for enterprises and industries are being implemented, supporting and implementing

research activities at educational and scientific organizations and enhancing the region's research and innovation potential. Public and private investments in human resource development are linked to innovation impact, often in conjunction with the strategic development goals of the territorial entity and its constituent entities. Based on this, goals and methods for enhancing the global competitiveness of universities are being defined. The competitiveness of higher education, as a system that largely determines the well-being of the population, can be characterized by quality, speed, and flexibility in adapting to global development trends, both obvious and emerging. The increasing role of international cooperation in the development strategies of modern universities necessitates assessing the success of such strategies. For example, in light of the ongoing global changes in the Eurasian scientific and educational space, the "6i" model, which synthesizes internationalization, impact, innovation, inclusiveness, and interdisciplinarity, is considered promising.

Researchers cite student and staff motivation, the organization of the internationalization process, the implementation of specific measures involving educational and research stakeholders, the size of the country in terms of territory and population, and the administrative resource requirements associated with a focus on innovative development, improving the quality of the workforce, and strengthening ties with international partners as key success factors. Specifically, according to published data, over 43% of university staff implementing the strategic directions of the relevant plan consider the internationalization process successful, while approximately 26% of staff at universities where such goals are set at the faculty and other department levels do so.

When assessing opportunities to improve competitiveness, it is important to consider the differentiation of universities based on various criteria. For example, the classification of European universities divides them into three groups: classical universities with a strong research component (more than 89% of universities in this group are engaged in research), universities of applied sciences, and specialized universities (music, art, etc.). Moreover, the distribution of students across university groups varies greatly across countries, making it inappropriate to discuss the inherent competitive advantages of any given university without reference to its specific operating conditions. The experience of Chinese universities is illustrative, particularly East China Normal University, which ranks 30th in the national ranking. It maintains relationships with over 80 leading universities worldwide, and over 100 foreign specialists have been invited as honorary professors and consultants as part of international cooperation. International students, however, account for only 10% of the total student population. Furthermore, we believe it is important to emphasize the importance of

balanced university development across key performance parameters, given the special role this characteristic plays in assessing competitiveness.

A key objective in assessing a university's competitiveness is to define a qualification framework as a tool that allows individuals outside the education sector to accurately assess the knowledge and skills of university graduates, including when assessing their position in the labor market. However, some argue that a universal method for assessing learning outcomes applicable to all universities is fundamentally impossible. However, while it may be possible to verify educational effectiveness, taking into account the specific characteristics of individual countries, education systems, and universities, appropriate official regulations must be developed.

An example of a ranking that primarily evaluates a university's engagement in international collaboration is one of the four modules of the Universitas 21 (U21) project. The project annually evaluates the higher education systems of 50 countries (the remaining three modules examine resources, political climate, and impact). Five indicators are used: the share of international students; the share of scientific publications co-authored with foreign scholars; the share of scientific publications produced through collaboration with industry; business representatives' opinions on knowledge sharing; and a webometric assessment of external views of the university's online materials. In interpreting the ranking results, the author notes that the overall ranking does not allow for assessing differences between countries in the aforementioned indicators, nor does it allow for tracing the relationships between them. In particular, an ambiguous conclusion is reached: the level of researchers' involvement in international interaction is inversely proportional to the size of the country's population, since a large country has a large scientific community and little need to interact with foreign colleagues.

It is significant that in this case, international branches of universities are playing an increasingly significant role in shaping the results of university rankings. Thus, the published results of the study indicate an increase in university productivity and the internationalization of science through the successful activities of their international branches. In particular, the share of publications prepared by representatives of international branches in collaboration with foreign scientists is higher than the same indicator for parent universities (data for China are 68 and 40%, respectively) [22, p. 23]. However, a clear explanation for this trend is not provided: the authors note the need to clarify the factors behind the identified dynamics, naming as possible the attraction of high-level foreign specialists, the desire to develop an academic culture, alignment with elite universities, etc. According to expert opinion, based on the analysis

of a number of studies, international rankings practically do not use indicators directly linked to the learning outcomes of university students or to the quality of this education. We agree with this statement, based on the importance of indicators of the level of international cooperation in the overwhelming majority of existing rankings. Thus, the internationalization strategy of Zhejiang University of China received the highest rating among universities in the Asian region, according to the international agency THE WUR. The strengths of the university's competitive strategy include: the involvement of all university departments in the internationalization process, active training of employees with international experience, investment in their personal and professional growth, the development of academic mobility programs, the synthesis of educational and scientific activities, the diversification of educational modes, and the creation of research laboratories in collaboration with foreign partners. In fairness, it should be noted that in some cases, the decisive factor in ensuring the implementation of effective measures leading to an increase in the competitiveness of universities in the global space is the funding of the relevant programs. First of all, this concerns state support, then private investment. According to experts, rankings monetize the results of universities' activities. However, in light of recent events, the situation of the overwhelming majority of universities around the world has significantly worsened as a result of restrictions caused by the coronavirus pandemic. The first thing that experts noted was the varying levels of resource availability of universities and their readiness for this kind of crisis; Digital inequality and digital literacy among educational participants; increasing university focus on supporting learning at the expense of preserving the core values of the academic community.
identifies three key issues facing the university community in this challenging period. First, student and staff mobility (a survey of American respondents showed that 94% of university students who had previously planned to go on exchange programs to China were forced to postpone their plans or cancel them altogether). Second, flexibility in implementing educational and research processes at universities. While these opportunities are limited by mobility restrictions, they are expanded by actively using the information network. A case in point is the strengthening of international ties between Voronezh State Technical University and its foreign partner universities. Liaoning University of Science and Technology (China) offered students and staff an online Chinese language course, and the Asian Electronic University announced a call for applications for an online scholarship program in a number of undergraduate and graduate programs.

Thirdly, this concerns students and staff during the pandemic. For example, the claim that the transition to online learning has a positive impact on public health and safety is questionable.

Thus, the competitiveness of a modern university in the Eurasian scientific and educational space is determined by global development goals and territorial development strategies. University performance is assessed based on adherence to global development trends and the quality of products and services, determined by the fundamental goals of these activities. There is no clear consensus regarding a universal assessment and recipe for success in international cooperation; expert opinions and researchers' positions are based on national, subjective values and goals. An analysis of the scientific literature shows that scholars agree with the definition of dynamic, continuous development of the scientific and educational environment, and that key drivers of competitiveness are the development of the scientific and educational environment.

Limitations

While promising, this development strategy faces several limitations. Infrastructure Instability: As highlighted by the 2022 blackouts (Estecahandy, 2023), research reliant on high-performance computing (e.g., training LLMs like KazMMLU (Togmanov et al., 2025)) is vulnerable to Kazakhstan’s unstable energy grid. A failure in basic utility provision can halt experimental physics or computational research. Funding Volatility: The reliance on FDI and government grants is risky. As shown in the UK context, austerity measures can fundamentally alter the competitive landscape, potentially disadvantaging institutions that haven't yet secured elite status (Sun et al., 2023). If South Korean or other international FDI flows (Lee et al., 2022) decrease, research funding for these new subjects may evaporate. The "Ungraded School" Gap: University competitiveness depends on incoming student quality. If the e-learning initiatives in rural ungraded schools fail to bridge the knowledge gap, universities will spend resources on remedial education rather than advanced research, stalling the S3 model. Ethical risks arise particularly in the commercialization of cultural assets. When developing subjects like Ethnomathematics (Hamann, 2023) or indigenous knowledge systems for global consumption, there is a risk of commodifying culture without benefiting the source communities. Additionally, the push for extensive data collection for NLP models (Togmanov et al., 2025) raises privacy concerns. The technology acceptance models used to measure portal usage must be rigorous to ensure that citizens (and students) are not being surveilled under the guise of "smart education." Future research should focus on two areas. First, expanding the dataset for KazMMLU (Togmanov et al., 2025) to include more dialectal variations and specialized

technical vocabulary, thereby creating a more robust foundation for Kazakh AI research. Second, an empirical study should be conducted applying the Modified PCA method (Vashchenko et al., 2022) specifically to Kazakhstani universities that have recently adopted internationalized curricula, to quantitatively measure the correlation between specific subject introduction and ranking movements. This would move the discussion from theoretical frameworks to empirical validation.

Conclusion

Enhancing the competitiveness of Kazakhstan's universities in QS rankings requires more than generic modernization; it demands the strategic development of subjects that convert local constraints into global assets. By synthesizing insights from educational informatization, ethno-cultural pedagogy, and advanced computational benchmarks (Togmanov et al., 2025), this paper proposes a pathway where Kazakhstan leads in niche fields such as Low-Resource NLP and Continental Climate Engineering (Yerdesh et al., 2022). While challenges regarding energy infrastructure (Estecahandy, 2023) and funding stability (Lee et al., 2022) (Sun et al., 2023) remain, the alignment of curriculum with both national heritage and global technological trends offers a viable route to academic excellence. The successful implementation of this strategy will depend on rigorous evaluation and the continued integration of research output with international scientific dialogue.

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