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Innovative technologies in higher education: developing international cooperation in professional training

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ABSTRACT

This study delves into the intricacies of employing innovative technologies to foster international cooperation in professional training across higher education institutions in Ukraine and Kazakhstan. Employing a blend of theoretical and systemic analysis, content review of documentary materials, exploration of higher education websites, and Global Innovation Index data analysis, the research unveils a broad utilisation of innovative technologies. The investigation highlights key challenges in the adoption of innovative technologies for international collaboration, pinpointing a scarcity of funding, qualified personnel, and inadequate industry-academia collaboration. This insufficient partnership hampers the development of curricula that align with market demands, technological advancements, and societal needs. The research suggests that increased governmental attention, educational institution management, and international cooperation programmes, alongside an investigation into industry requirements, will bolster more effective collaboration. It will also enhance the implementation and usage of innovative technologies for a myriad of international academic exchanges. Addressing the identified challenges can expand the usage of these technologies, thereby elevating the quality of international education for students. This, in turn, enriches international cooperation, intercultural interaction, and experience sharing, marking the study's significant contribution to the academic discourse on leveraging innovative technologies for global educational collaboration.

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Introduction

The internationalisation of higher education institutions is a trend in the development of higher education. The main motivation for the attention of higher education administrations to international activities has always been its potential to support national security, public diplomacy, and economic development. In a rapidly changing world and with increasingly high demands on the qualifications of specialists, innovative technologies are playing an increasingly important role in higher education (Qureshi et al. 2021). There are not many studies on the development of innovative technologies in higher education in the context of international cooperation between Ukraine and Kazakhstan. In particular, Akkari et al. (2023) investigated strategies to increase

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internationalisation in Kazakhstan, such as the employment of international scholars and the opening of foreign institutions in the country, and the use of English as a tool for internationalisation at the local level. The problem of teaching English in Kazakhstan is highlighted. Karpenko et al. (2021) emphasises the importance of international cooperation for increasing competitiveness in the market of educational services and participation in international projects, one of the areas of higher education reform. The international community is creating pathways for social change in Kazakhstan by developing local talent, strengthening institutional linkages, protecting the environment, and improving public and private responses to deep socio-economic and cultural challenges (Jonbekova 2023).

Cooperation between higher education institutions in Ukraine and Kazakhstan has been steadily strengthening over the years. Both countries recognise the importance of introducing innovative technologies in the process of internationalisation of education, participate in student exchange programmes and joint research projects to promote cultural understanding and knowledge exchange. In the last 15 years, the number of studies in the field of education has increased, and Kazakhstan occupies a prominent place in the Central Asian countries (Hernández-Torrano et al. 2021).

In modern conditions, there is a development of intercultural relations and active cooperation of higher education institutions from different countries to improve the exchange of experience in the field of education. Klymenko and Alpeissova (2021) the introduction of digitalisation under quarantine conditions were studied, which allowed formulating of new strategies for adapting to the needs of restrictions on social activity in higher education institutions of Ukraine and Kazakhstan and the development of innovative tools in the educational process.

Stavytskyy et al. (2019) highlight a number of challenges to the development of innovation in higher education institutions in Ukraine, in particular, the lack of investment in research and innovation, the weak level of intellectual property protection, insufficient cooperation with the government, international scientific societies and industry. At the same time, there is a lack of research on the peculiarities of applying innovative technologies in the process of international cooperation between higher education institutions of Ukraine and Kazakhstan.

The ongoing Russian-Ukrainian war has significant consequences for international partnerships, in particular between higher education institutions of Ukraine and Kazakhstan. Geopolitical tensions and the immediate impact of the war on Ukraine create logistical and safety challenges for student exchange programmes and joint research projects. Universities in Ukraine are facing unprecedented challenges, including damage to infrastructure and disruptions to academic schedules (Tavrovetska and Veldbrekht 2023). The economic impact of the war on Ukraine leads to a redistribution of resources, potentially affecting the funding of international partnerships and research initiatives. However, it could also lead to increased funding for projects related to conflict resolution, peace studies and reconstruction. While the Russian-Ukrainian war poses challenges for the Ukrainian-Kazakhstan academic partnership, it also opens up avenues for deepening cooperation through innovation, sustainability, and a focus on addressing today's global challenges.

So, the purpose of the study is to investigate the peculiarities of the use of innovative technologies in the international cooperation of higher education institutions for the professional training of specialists in Ukraine and Kazakhstan. Building on this aim, the research can be designed around several key objectives:

1. Evaluate the impact of digital transformation on international cooperation in higher education, focusing on student and faculty exchange programmes, joint research, and the development of educational content.
2. Identify the challenges and opportunities presented by the integration of innovative technologies in higher education, including infrastructure needs, pedagogical integration, and digital skill development among faculty and students.

3. Propose strategies to enhance the effectiveness of innovative technologies in promoting international cooperation, addressing issues such as cross-cultural communication, language barriers, and the development of joint research and development projects.

Literature review

International education in a global environment is constantly evolving (Zapp, Marques, and Powell 2021), so global competence is the basis of employment and citizenship, and it is included in the list of new abilities required by future professionals (Karanikola, Katsiouli, and Palaiologou 2022). Students in today's world need to be open-minded, and curious and have developed skills in communicating with people from other cultures and nationalities (Ivenz and Reid 2022). The importance of intercultural communication is especially growing with the development of opportunities for intercultural communication, and communication through the development of digital means (Chen 2022). Students support university initiatives to develop intercultural communication and propose various ways of developing it, including the use of innovative technologies (Sercu 2023).

The internationalisation of higher education is defined as the process of integrating an international, intercultural dimension in order to improve the quality of education and research for students and staff, and to make a significant contribution to the development of society (Rosyidah and Rosyidi 2020; Simões and Sangiamchit 2023). According to Diatta (2019), intercultural competence is the ability of people to understand, interact and work with people from other cultures on the basis of respect, mutual understanding, and dialogue.

Kazakhstan is taking many measures to internationalise higher education, including medical education. Specifically, participation in the Erasmus + and Tempus projects, which used an integrated curriculum based on problem-based, team-based learning, and virtual patient cases, positively influenced the development of academic mobility and human resources.

Innovation and internationalisation of higher education contribute to improving the level of academic knowledge and efficiency of education, which is especially important in technological development (Zapp, Marques, and Powell 2021). Innovation is the introduction of new ideas or technologies in fundamentally different ways than in the past (Lee and Trimi 2018). Therefore, the internationalisation of higher education definitely involves the introduction of innovations in the learning process, as the development of technology and labour market requirements requires continuous improvement of educational programmes.

Komar and Oksiutenko (2023), and Morze et al. (2023) discuss the digitalisation of educational processes, emphasising the transition towards online education and the development of digital ecosystems within universities. These contributions underscore the potential of digital technologies to transform educational delivery and infrastructure. On the internationalisation front, Issabekov et al. (2022) explore various aspects of higher education internationalisation in Kazakhstan, including strategies to attract foreign students, the role of government scholarships in fostering social change, and university-business cooperation as a catalyst for economic development. These studies reveal the multifaceted approach to internationalisation, highlighting both successes and challenges in integrating global perspectives into local educational systems. Rensimer and Brooks (2024) delve into the broader implications of international cooperation and research in education. They discuss the impact of internationalisation on educational reform, the disparities in education research production among post-Soviet countries, and the potential for further stratification within European higher education due to the European Universities Initiative. These insights point to the complex dynamics of educational internationalisation, including the balance between global collaboration and the risk of reinforcing existing inequalities.

The challenges of online learning are examined by Tavrovetska and Veldbrekht (2023), and Zhukova et al. (2023), who identify psychological impacts and the need for developing educators' digital skills. These concerns underscore the necessity of addressing both technological and human factors

in the successful implementation of digital education. Lastly, Bykova, Ivashchenko, and Kovalchuk (2021) and Shyiramunda and van den Bersselaar (2024) address pedagogical and community aspects of education, emphasising the importance of cross-disciplinary approaches and the role of higher education institutions in local community development. These perspectives highlight the need for educational practices that not only embrace technological innovation but also respond to the needs of diverse communities.

Here's a comparative Table 1 of the main bibliographical references and their scientific contributions to the field of initial academic study, providing an overview of the advantages and disadvantages of the study carried out.

The selected studies highlight a variety of methodologies, from bibliometric analysis and literature reviews to case studies and comparative analyses, offering insights into digitalisation's role in learning effectiveness, the strategies and challenges of higher education internationalisation, and the importance of university-business cooperation in fostering innovation and economic development across different geographical contexts.

In this context, the current study contributes significantly to the body of knowledge by integrating the themes of digital transformation and internationalisation within higher education. It offers a unique comparative analysis of Ukraine and Kazakhstan, providing insights into how these countries navigate the challenges and opportunities presented by digitalisation and global educational collaboration. Unlike previous studies that focus on specific aspects of digitalisation or internationalisation, this research offers a holistic view, addressing the interplay between technological advancements, international cooperation, and educational reform. However, it also faces limitations related to the scope of data and the rapidly evolving nature of digital technologies and international educational policies, which may affect the generalizability of its findings.

Material and methods

The study was conducted using the methods of theoretical analysis and systematic review, content analysis of literature, regulatory legislative, and reporting documents on the international activities

Table 1. Comparative Overview of Bibliographical Contributions to Digital Transformation and Internationalisation in Higher Education.

Reference	Focus	Methodology	Findings	Geographical Focus
Qureshi et al. (2021)	Impact of digital technologies on learning effectiveness	Bibliometric analysis, PRISMA statement review	Digital technologies enhance educational growth and development of high-tech skills	General/Not specified
Akkari et al. (2023)	Higher education internationalisation in Kazakhstan	Literature review, analysis of student flows	Identification of strategies for internationalisation, including foreign student attraction and language policy	Kazakhstan
Karpenko et al. (2021)	Role of international cooperation in higher education reforms in Ukraine	Case study analysis	International cooperation enhances educational quality and reforms	Ukraine
Klymenko and Alpeissova (2021)	Education digitalisation under quarantine in Ukraine and Kazakhstan	Comparative analysis	Digitalisation as a response to quarantine, highlighting both challenges and opportunities	Ukraine and Kazakhstan
Morze et al. (2023)	Development of digital ecosystems in universities	Comparative study of universities in Ukraine, Poland, and Slovakia	Insights into successful digital ecosystem models and their implementation challenges	Ukraine, Poland, Slovakia
Issabekov et al. (2022)	University-business cooperation in Kazakhstan's innovative economic development	Documentary analysis method	University-business partnerships contribute significantly to innovation and economic development	Kazakhstan

of higher education institutions in Ukraine and Kazakhstan. To identify relevant studies and research related to the role of innovative technologies in promoting international cooperation in professional training in higher education comprehensive literature review was conducted. The literature review was carried out using various databases such as Google Scholar, Web of Science, and Scopus. Keywords used for the search included 'innovative technologies' 'professional training' 'international cooperation' and 'higher education'. Relevant articles were selected to the research question were selected. The article also analyses global innovation index data on the implementation of innovations in Ukraine and Kazakhstan over the past 3 years (2020–2022).

The analysis of the selected 46 articles focused on innovative technologies' role in enhancing international cooperation in higher education, utilising a thematic synthesis to organise and interpret the findings. This comprehensive review illuminated the significant contribution of technologies like MOOCs, virtual reality, and artificial intelligence in facilitating cross-border educational collaborations, offering students and faculty alike a platform for global interaction and shared learning experiences. The primary outcomes of this analysis underscored the dual nature of innovative technologies in higher education: as facilitators of expanded international collaboration and as sources of challenges needing strategic responses. Key benefits identified include the democratisation of access to global educational resources and the fostering of an international academic community. However, the analysis also highlighted challenges such as digital divide, the necessity for improved digital literacy, and the need for substantial infrastructural and pedagogical support systems. Conclusively, the study posited that while innovative technologies hold transformative potential for international cooperation in professional training, realising this potential fully requires addressing the identified challenges through targeted investment in infrastructure, digital skills enhancement, and equitable technology access policies. This balanced approach can propel higher education institutions toward leveraging technology effectively for a more integrated and collaborative international educational landscape.

In addition to the literature review, relevant documents, reports, and policy documents were also reviewed to provide additional insights into the topic. Documents were selected based on their relevance to the research question and were obtained from various sources, including government agencies, international organisations, and higher education institutions.

The documents reviewed included policy reports on the use of innovative technologies in professional training in higher education, case studies of successful international collaborations in higher education, and research studies on the impact of innovative technologies on teaching and learning in higher education.

The study extended its analysis to the use of innovative technologies for international cooperation by examining the websites of 30 higher education institutions, equally divided between Ukraine and Kazakhstan. These institutions were selected based on their active participation in international programmes and the utilisation of innovative technologies in professional training. The websites were evaluated according to specific criteria: the extent of international cooperation initiatives, mention of innovative technologies (e.g. online platforms, virtual reality, MOOCs), documented successful international projects, and evidence of collaborative research with international entities. This targeted analysis aimed to glean insights into the practices, challenges, and impacts of leveraging technology in fostering international educational collaboration, thereby enriching the study's findings with practical examples from the field. The data collected through the literature and document review were analysed using a thematic analysis approach. Key themes and patterns in the data were identified and analysed to provide insights into the role of innovative technologies in promoting international cooperation in professional training in higher education.

The thematic analysis involved identifying and organising the key ideas and concepts presented in the literature and documents reviewed. The identified themes included the benefits and challenges of using innovative technologies in international collaboration, the impact of innovative technologies on learning and teaching, and the strategies for promoting international cooperation in professional training using innovative technologies. This study adhered to ethical principles

involving secondary data analysis. No participants were involved in the study, and all data collected were publicly available. The study aimed to ensure the accuracy and integrity of the data used in the analysis.

The limitation of this study is the potential for publication bias, as the articles and documents selected may not represent the entire body of research on the topic. The study was conducted on international cooperation in higher education institutions of the countries of Kazakhstan and Ukraine, and the peculiarities of cooperation of higher education institutions between these countries. Additionally, the study relied on secondary data, which may have limitations regarding the scope and depth of the available data. Finally, the study may be influenced by the biases and prospectives of the authors of the reviewed articles and documents.

Results

The digital transformation of educational institutions and the introduction of innovative technologies help to improve the learning process and automate many operations. Digital transformation has improved various areas and processes of management and education in higher education institutions. In particular, admission to higher education institutions, the possibility of online learning, and improved learning outcomes.

Comparing the indicators of the Global Innovation Index of Ukraine and Kazakhstan, which allow to assess the state and problems of introducing innovations in education, the following data were obtained (Table 2).

Ukraine slightly lost its position in 2022 compared to 2022, which is explained by the martial law. However, Kazakhstan also moved from 77th to 83rd place. An analysis of the peculiarities of innovation and international cooperation between higher education institutions in Ukraine and Kazakhstan shows that exchange programmes are currently the main source of international cooperation. Exchange programmes allow students, teachers, and professionals to transfer knowledge and skills with their colleagues from different countries. There are the following types of programmes: the forms of cooperation include student exchanges, joint research, and projects, teaching joint courses and programmes, involvement of renowned scientists in international cooperation, capacity Development Programmes, etc. In addition to mobility programmes, innovative technologies have been actively developed in recent years, which allow the subjects of the educational process to cooperate and develop international educational programmes.

The analysis of information on the websites of higher education institutions in Ukraine and Kazakhstan shows the following examples of the use of innovative technologies for international cooperation:

- zoom video conferencing for organising online meetings with partners (Zoom);
- electronic systems to provide access to scientific sources and materials for students and teachers (ResearchGate, Google Scholar);
- E-learning platforms, which allow students to collaborate on group projects and assignments, which help to develop their teamwork skills and encourage cross-cultural communication.

Table 2. Global Innovation Index Data (in Ukraine and Kazakhstan during 2020–2022).

	Ukraine						Kazakhstan					
	Rank			Score			Rank			Score		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Overall	45	49	57	36.3	35.6	31.0	77	79	83	28.6	28.6	24.7
Innovation Input Sub-Index	71	76	75	40.1	39.6	35.7	60	61	65	42.8	42.5	38.4
Innovation Output Sub-Index	37	37	48	32.5	31.6	26.4	94	101	97	14.3	14.7	11.0

Source: compiled by the authors based on Global Innovation Index (2023).

These platforms help students access educational resources, participate in online discussions, and collaborate on projects (Canvas, Moodle);
– video materials, webinars, and web seminars for online courses for foreign students and teachers (YouTube, Vimeo);
– communication through social networks (Facebook, LinkedIn);
– development of massive open online courses (MOOCs). These courses are designed to be accessible to a large number of participants from all over the world. The courses provide access to high-quality educational resources and allow you to collaborate with students from different countries (Coursera, edX);
– online learning communities – designed to facilitate communication and collaboration among the participants of education process from different countries. The community provides a platform for sharing knowledge, exchanging ideas, and collaborating on research projects which helps to promote international cooperation in higher education (Slack, Discord);
– mobile applications for effective communication between international students and academic advisors (WhatsApp, Telegram);
– software products based on artificial intelligence for data analysis and processing in the field of engineering and technology (TensorFlow, IBM Watson);
– virtual reality for conducting interactive lectures and conducting various research in the field of medicine and biology, agriculture, and others (Oculus Rift, HTC Vive);
– virtual mobility programmes – students' education without the need for physical travel. Thanks to the development of this sphere, it is possible to collaborate on joint educational projects, cooperate with students and teachers from different countries, and gain access to technologies that are not yet developed in your country (Erasmus + Virtual Exchange);
– information systems for research accounting and analysis (ORCID, SciVal);
– conducting virtual excursions and scientific conferences, which allows students and teachers to participate in international cooperation without physically visiting other countries (Google Earth VR, AltspaceVR);
– teaching foreign languages through interactive platforms and software, allowing students from other countries to learn more effectively (Duolingo, Babbel);
– open-source software to develop innovative projects with partners from other countries (GitHub, SourceForge);
– the use of 3D printing to create prototypes of inventive solutions and products with partners from other countries reduces the cost of creating and testing prototypes and accelerates the development of new products, mechanical devices, and electronics (MakerBot, Ultimaker).

According to the Human capital and research data, which allows to assess the development of innovation activities, there have been quite large fluctuations in Ukraine and Kazakhstan over the past three years (Table 3).

Table 3. Human capital and research (in Ukraine and Kazakhstan during 2020–2022).

	Ukraine						Kazakhstan					
	Rank			Score			Rank			Score		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Overall	39	66	49	40.5	31.7	36.6	68	44	60	29.7	38.2	32.7
Research and developement	44	58	59	20.5	10.4	9.6	57	54	51	10.4	10.9	13.1
Researches*	52	51	54	11.7	11.6	9.6	62	61	62	7.9	7.8	7.1
Gross expedinture on R&D (GERD)	69	69	68	9.3	9.3	7.3	101	103	101	2.2	2.1	2.3
QS university ranking average score top 3 universities	49	51	48	21.2	20.6	20.3	37	36	36	31.6	33.8	34.7

Source: compiled by the authors based on Global Innovation Index (2023).

Table 4. Infrastructure (in Ukraine and Kazakhstan during 2020–2022).

	Ukraine						Kazakhstan					
	Rank			Score			Rank			Score		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Overall	94	94	82	33.1	32.3	38.7	66	58	58	40.8	44.4	46.2
Information and communication technologies (ICTs)	82	69	63	58.8	64.9	74.9	42	29	25	76.3	80.5	85.7
ICT access	65	69	66	65.9	65.0	86.6	42	43	43	75.2	76.6	90.2
ICT use	89	91	62	43.7	45.6	63.8	58	56	51	59.6	64.9	72.2
Government's online service	93	72	72	56.9	68.2	68.2	32	11	11	86.8	92.4	92.4
Online E-participation	74	46	46	68.5	81.0	81.0	42	26	26	83.7	88.1	88.1

Source: compiled by the authors based on Global Innovation Index (2023).

Analysing the development of infrastructure specifically for the use of ICTs, it is possible to conclude that there has been clear progress in both countries (Table 4).

The analysis of implementation and use of innovations for the development of international cooperation in the field of higher education in Kazakhstan and Ukraine reveals common problems in both countries. These are infrastructure and access disparities to enable the integration of innovative technologies for students from different locations (rural and urban) and with different income levels. In both Ukraine and Kazakhstan, there is a need to invest in the development of high-speed internet, reliable electricity supply, and sufficient and appropriate quality technological resources to ensure equal access to learning and the use of innovative technologies. It is crucial for government institutions to prioritise infrastructure development initiatives, invest a digital infrastructure, and implement targeted interventions to bridge the access gaps.

Business sophistication indicators related to the development and the use of innovations show progress in both countries (Table 5). The largest increase in development indicators in both countries is in Hi-tech imports. Research talent in business enterprise is not developed at all in Kazakhstan, with a score equal to 0.

A lack of pedagogical integration and instructional design of innovations are the next problem in both countries. Agiling technologies with traditional pedagogical practices, resulting in limited effectiveness impacts on students' learning outcomes. Institutions need to promote the development of innovative pedagogical strategies that leverage technology to foster active learning, student engagement, and critical thinking skills. Collaborative efforts among faculty members should be encouraged to develop and share innovative instructional approaches that align with the specific needs and context of professional training programmes. By emphasising pedagogical integration and instructional design, higher educational institutions in Ukraine and Kazakhstan can maximise

Table 5. Business Sophistication (in Ukraine and Kazakhstan during 2020–2022).

	Ukraine						Kazakhstan					
	Rank			Score			Rank			Score		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Overall	54	53	48	29.5	28.9	32.3	71	78	68	24.3	23.0	26.9
Innovation linkages	81	84	78	18.8	18.0	21.3	124	120	123	13.0	12.9	14.3
University/industry research collaboration	50	67	73	45.5	42.3	41.5	68	95	117	40.9	36.0	29.6
State of cluster developement	91	100	104	40.9	40.3	39.9	114	117	120	33.9	32.8	33.9
GERD financed by abroad	36	38	36	16.7	14.4	17.7	89	90	88	0.5	0.4	0.5
Knowledge absorbtion	59	59	63	30.6	29.7	30.6	91	97	89	22.6	19.0	25.2
Hi-tech imports	33	36	47	32.1	33.1	26.4	72	70	40	21.3	23.2	28.6
ICT services imports	74	78	79	14.4	22.5	22.0	92	93	88	10.7	15.4	16.1
Research talent in business enterprise	47	45	46	32.5	33.1	33.1	0	0	0	0.0	0.0	0.00

Source: compiled by the authors based on Global Innovation Index (2023).

the potential of innovative technologies to enhance learning experiences and prepare students for the demands of the modern workforce.

An analysis of Knowledge and technology outputs shows that Kazakhstan has seen little fluctuation over the past 3 years (Table 6), while Ukraine has dropped its position in the ranking from 25th place in 2020 to 36th in 2022. This is again due to martial law. In Ukraine, all the indicators of Knowledge and technology outputs, Knowledge creation, diffusion, High-tech exports, and ICT services exports decreased, while in Kazakhstan, some indicators increased in 2021 (Knowledge diffusion) and decreased again in 2022.

Analysis of the Global Innovation Index data shows that both countries have taken many steps to promote innovation and strengthen and expand international partnerships but, in some indicators, the level of innovation in Ukraine and Kazakhstan has declined.

Also, the analysis of data in scientific publications shows problems as gaps in faculty development and the digital skills of students and teachers. Effective integration of innovative technologies in higher education relies on well-trained faculty members equipped with the necessary digital skills. There is a notable gap in digital skills among faculty members, hindering their ability to effectively integrate and use technologies into teaching practices. Training practices, workshops, and mentoring opportunities can empower faculty members to leverage innovative technologies effectively, resulting in improved teaching and learning experiences.

The next problems are cross-cultural and language barriers. Promoting international cooperation in professional training involves collaboration among individuals from diverse cultural and linguistic backgrounds. Ukraine and Kazakhstan encounter challenges related to cross-cultural communication and language barriers. There is also a need to expand international cooperation in different regions of the country, including regions with a large share of ethnic minorities. Efforts should be made to provide language support services, cultural sensitivity training, and platforms for intercultural exchange. Language barriers can be addressed through language courses, translation services, and language proficiency requirements for international collaboration programmes. Cultural sensitivity training can enhance mutual understanding and effective communication among students and educators from different cultural backgrounds. Additionally, creating platforms for intercultural change, such as joint research programmes and virtual collaboration can foster cross-cultural learning experiences and promote international cooperation.

Another problem is the focus on academic exchange programmes rather than joint research and development projects, a shortage of qualified personnel, as well as a lack of electronic cooperation between the scientific community and industry and the military conflict in Ukraine, which greatly complicates the educational process in general. Addressing these gaps in the development, implementation, and use of innovative technologies for international cooperation in the field of professional training, expanding access to the necessary digital skills, and developing international cooperation in higher education institutions at various levels will contribute to the development and success of innovative technologies for learning and cooperation between Ukraine and Kazakhstan.

Table 6. Knowledge and Technology Outputs (in Ukraine and Kazakhstan during 2020-2022).

	Ukraine						Kazakhstan					
	Rank			Score			Rank			Score		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Overall	25	33	36	35.1	32.3	32.9	80	86	81	15.8	15.0	17.8
Knowledge creation	23	27	29	41.6	35.7	30.4	72	66	66	11.7	14.9	12.3
Knowledge diffusion	32	35	42	35.0	29.8	35.4	76	91	71	20.2	11.0	20.8
High-tech exports	56	60	64	28.6	7.8	27.4	44	42	36	38.5	16.2	46.9
ICT services exports	9	9	7	54.7	53.5	60.5	115	122	115	2.2	1.8	2.1

Source: compiled by the authors based on Global Innovation Index (2023).

Discussion

The review of scientific sources shows the importance of introducing innovations for the quality of education (Bygstad et al. 2022; Haleem et al. 2022), but there is a lack analysis of the problems of using and introducing innovations in the context of international cooperation. Advancements in technology have revolutionised the way of accessing and disseminating information. Comprehensive modernisation of the economy and education is required to realise innovation potential (Kinash et al. 2019). The analysis of the Global Innovation Index shows insufficient development of innovations and their use in Ukraine and Kazakhstan. Collaboration with information from university websites reveals emerging problems in the implementation and use of innovative technologies for education and international cooperation. It is necessary to develop communication skills, critical thinking, and conceptualisation, introduce them to the latest technologies, and integrate new learning tools and technologies (Crittenden, Biel, and Lovely 2019). Students need to develop progressive thinking, and the ability to observe and adapt to the changing conditions of the external world (Poplavskyi 2021). Integrating innovation with participation in international study programmes is the most effective way to develop such skills for students. Innovative technologies are actively used in the process of international cooperation between universities, including online courses, webinars, expanding the network of professional contacts, using new technologies, virtual reality to create international educational programmes, and using platforms for experience exchange (Coursera, edX, etc.) (Francescucci and Rohani 2019; Haleem et al. 2022).

The digital transformation of the global higher education industry is defining a sustainable education management strategy (Hashim, Tlemsani, and Matthews 2022). According to Kraus et al. (2021), for the success of the use of technology, it is important to select and combine them correctly, and to manage technology effectively in order to establish effective cooperation between teachers and students. Expanding the use of technology and access to it for all students can improve the quality of students' education and accessibility of education for students with different income levels (Al Rawashdeh et al. 2021). Innovative technologies are not always available for use or study for students with different income levels, but they can be applied to solve various problems in many different areas (Mukhamadeyeva 2020) and makes it possible to use tools for teaching students in higher education institutions and obtaining quality education in universities around the world (Zhukova et al. 2021). Therefore, receiving study grants or participating in international exchange programmes opens up wide opportunities for students and researchers to develop in various fields.

As studied by Jumakulov and Ashirbekov (2016), Jumakulov et al. (2019), the goal of the government of Kazakhstan is becoming one of the top 30 developed countries by 2050 through the creation of appropriate infrastructure, development of priority industries, transfer of technologies from developed countries, and training of specialists at the appropriate level. This is done by sponsoring academic mobility programmes, signing international cooperation agreements, establishing accreditation rules, creating an international university, and the Bologna process. The peculiarities of higher education legal regulation in Kazakhstan and recommendations for its improvement were studied and described in the study by Movkebayeva et al. (2021). Analysis of the existing problems and development of Kazakhstan allows to identify them and solve them, which contributes to the achievement of the goals of international cooperation and innovation.

The challenges of using innovative technologies in international higher education cooperation are mismatch of student and faculty skills, lack of development and funding, the need for sustainable funding, a lack of pedagogical integration and instructional design of innovations, infrastructure, and access disparities, cross-cultural and language barriers which complements the findings of Mercader (2020), who argues that there are seven main obstacles to technology integration: technophobia, lack of time, lack of planning, lack of incentives, assessment, workload, and university accreditation model. Also, the data obtained complement the study by Gryshkova (2019), the problems of internationalisation and the introduction of innovations in both countries have problems

in the system of higher education. These problems include a lack of funding, outdated curricula, infrastructure, and private investors and research customers.

Such as these problems can be improved through various best practices (Graf and Lohse 2021). Novikova et al. (2020) suggests using communication tools (media and social platforms) for this purpose, while Bugrov, Sitnicki, and Serbin (2021) emphasises the management of creative industries in university libraries, where innovative resources can be created and creative projects can be implemented. Vorontsova et al. (2020) argues for decentralising education, developing public-private enterprises, and stimulating adult education. At the same time, a significant increase in the diversity of educational institutions contributes to the development of large-scale changes in national higher education systems and international cooperation (Zapp, Marques, and Powell 2021). The development of international cooperation in the field of training is essentially a bilateral process. After all, by developing future specialists, countries contribute to the development of their economies and living standards in general, and according to Kaliisa, Palmer, and Miller (2019) teaching and use of technology in higher education differs significantly between developing and developed countries and teachers with sufficient training in the use of information and communication technologies report fewer barriers to the introduction of innovations and technologies in teaching. Trunina, Khovrak, and Bilyk (2020) developed a system for creating academic entrepreneurship for higher education institutions, stages of creating sustainable academic entrepreneurship, and performance indicators for the ability of a higher education institution to create and maintain the functioning of academic entrepreneurship. This allows to improve the quality of higher education, establish cooperation with business, and take into account the needs of the market in training specialists.

Polyakov et al. (2022) and Dzimińska, Fijałkowska, and Sułkowski (2020) define that universities play the role of an agent of cultural change for sustainable development, and they should be the main channel for initiating, promoting, and modelling changes oriented toward sustainable development. A culture of quality is required in all activities of universities to succeed as agents of cultural change Dzimińska, Fijałkowska, and Sułkowski (2020) and Fumasoli and Rossi (2021) investigated that there are different opportunities in different universities to engage in academic exchange projects, including quantitative and qualitative limits. Transnational learning networks that develop exchange programmes are constantly evolving phenomenon and universities play a key role in them. But at the same time, other participants in these projects can be effective in learning and teaching, as universities often prefer to teach certain topics while ignoring others.

Effective international cooperation in education and the sustainable application of innovations require sufficient funding and institutional support and teachers' initiative to introduce innovations (Zapp, Marques, and Powell 2021). Teachers need technological competencies and soft skills to implement and use innovations (Ramírez-Montoya et al. 2021). This requires raising the overall level of competence development, and teachers need to have the highest level of digital skills, information processing and teaching skills for professional training. The analysis of innovation implementation in Ukraine and Kazakhstan shows a lack of development in many areas of innovation implementation and use, which hinders the development of the required level of competence for teachers and students. Universities and teachers working in the direction of international cooperation are practically the founders of innovation not only for international cooperation but also for the development of their country.

A significant limitation of this research arises from the comparison of innovation indicators between countries experiencing vastly different socio-political conditions, specifically, comparing a country engaged in war with one at peace. The inherent challenges and disruptions caused by war, including its impact on infrastructure, education, and innovation capacities, may skew the comparative analysis. Therefore, while providing valuable insights, this study's comparisons should be interpreted with caution, acknowledging the unique circumstances that might influence the innovation indicators of the countries in question.

Conclusions

The findings reveal that digital technologies are pivotal in improving learning processes, facilitating administrative operations, and enabling international collaboration through exchange programmes, joint research, and online learning platforms. Despite the progress in digital infrastructure and the adoption of innovative tools for learning and cooperation, both Ukraine and Kazakhstan face challenges, including disparities in access to digital resources, pedagogical integration, and the need for faculty development in digital skills. Cross-cultural and language barriers further complicate international cooperation, highlighting the necessity for targeted interventions to support language proficiency and cultural sensitivity among students and educators. Moreover, the focus on academic exchanges over joint research projects and the underutilisation of digital technologies in bridging the gap between academia and industry are identified as areas requiring attention.

To overcome these obstacles, the study recommends investing in digital infrastructure, enhancing pedagogical strategies to incorporate innovative technologies, and developing comprehensive programmes for faculty and student digital literacy. Promoting joint research and development initiatives, alongside academic exchanges, could lead to more substantial international cooperation and innovation. In conclusion, while the path towards fully integrating innovative technologies in higher education's international cooperation faces several challenges, the potential benefits in terms of educational quality, international collaboration, and professional training are immense. Addressing the identified challenges through strategic planning and targeted interventions can pave the way for a more inclusive, effective, and innovative higher education system in both countries.

Disclosure statement

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