

KNOWLEDGE HUBS IN TIMES OF CRISIS: THE ECONOMIC AND STRATEGIC ROLE OF UNIVERSITIES IN INTERNATIONAL RESILIENCE NETWORKS

УНІВЕРСИТЕТИ ЯК ЦЕНТРИ ЗНАНЬ У КРИЗОВИЙ ПЕРІОД: ЕКОНОМІЧНА ТА СТРАТЕГІЧНА РОЛЬ ВИЩОЇ ОСВІТИ У МІЖНАРОДНИХ МЕРЕЖАХ СТІЙКОСТІ

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Abstract. *This article explores the role of universities in frontline regions as strategic knowledge hubs contributing to international resilience networks amid wartime conditions. Using the case of the National Aerospace University "Kharkiv Aviation Institute" (KhAI), the study analyzes the modernization of educational content and internal quality assurance systems as tools of institutional resilience and economic sustainability. The authors present an integrated model that combines ESG standards, national accreditation requirements, and internal digital innovations to support educational continuity under crisis. The paper highlights the significance of hybrid learning, the creation of safe academic environments, stakeholder involvement, and academic integrity in transforming universities into centers of regional stability and global integration. The findings suggest that KhAI's model can serve as a blueprint for higher education institutions operating in crisis-affected areas, supporting national human capital recovery and international cooperation in the field of education. The scientific novelty of the study lies in introducing the concept of an "educational-regional trajectory" as an innovative approach to preserving knowledge hubs in frontline regions, as well as in developing the model of "safe education", which combines the use of shelters as learning spaces with hybrid formats and digital quality monitoring systems. This makes it possible to consider the KhAI experience not only as a local case, but as a universal model for modernizing higher education under wartime challenges. The practical significance of the study is defined by the applicability of its results to the activities of higher education institutions in Ukraine and includes the following aspects: the proposed practices can be adapted and implemented to ensure the continuity of education under threat; the results may serve as a basis for developing regional education development programs aimed at enhancing the resilience of educational environments and preserving human capital; the outlined approaches to modernizing educational content and internal quality assurance can form the foundation for further research on educational innovation, risk management, and educational recovery strategies; the outcomes of this study serve as a strong*

argument in favor of supporting Ukrainian universities, which continue to demonstrate resilience and innovation despite the war.

Key words: *education modernization, resilience, frontline universities, quality assurance system, hybrid learning, digitalization, academic integrity, international cooperation*

Анотація. У статті досліджується роль університетів прифронтових регіонів як стратегічних центрів знань, що сприяють формуванню міжнародних мереж стійкості в умовах воєнного стану. На прикладі Національного аерокосмічного університету «Харківський авіаційний інститут» (ХАІ) проаналізовано процес модернізації змісту освіти та внутрішньої системи забезпечення якості як інструментів інституційної стійкості та економічної життєздатності. Представлено інтегровану модель, що поєднує стандарти ESG, національні вимоги до акредитації та внутрішні цифрові інновації для забезпечення безперервності освітнього процесу в умовах кризи. Наголошено на важливості гібридного навчання, створення безпечного освітнього середовища, залучення стейкхолдерів і підтримання академічної доброчесності у перетворенні університетів на осередки регіональної стабільності та глобальної інтеграції. Доведено, що модель ХАІ може слугувати орієнтиром для закладів вищої освіти, які функціонують в умовах кризи, сприяючи відновленню людського капіталу та міжнародному співробітництву у сфері освіти. Наукова новизна роботи полягає у введенні концепту «освітньо-регіональної траєкторії» як інноваційного підходу до збереження центрів знань у прифронтових регіонах, а також у розробці моделі «безпечної освіти», що поєднує використання укриттів як навчальних просторів із гібридними форматами та цифровими системами моніторингу якості. Саме це дозволяє розглядати досвід ХАІ не лише як локальний кейс, а як універсальну модель модернізації вищої освіти в умовах воєнних викликів. Практична значущість результатів роботи визначається можливістю їх застосування у діяльності закладів вищої освіти України та полягає у наступному: запропоновані практики можуть бути адаптовані й впроваджені для збереження освітнього процесу в умовах загроз; результати можуть слугувати основою для розробки регіональних програм розвитку освіти, спрямованих на підвищення стійкості освітнього середовища та збереження людського капіталу; окреслені підходи до модернізації змісту освіти та внутрішнього забезпечення якості можуть стати підґрунтям для подальших досліджень з питань інновацій в освіті, управління ризиками та формування стратегій освітнього відновлення; напрацювання роботи є аргументом на користь підтримки українських університетів, які, незважаючи на війну, демонструють стійкість та інноваційність.

Ключові слова: *модернізація освіти, стійкість, університет прифронтового регіону, система забезпечення якості, гібридне навчання, цифровізація, академічна доброчесність, міжнародне співробітництво.*

Introduction. Modern global and national challenges require higher education institutions not only to maintain stability but also to continuously modernize their educational content. In the context of war, where a significant portion of the educational process occurs in regions with heightened security risks, such as Kharkiv, the need for a high-quality renewal of the educational environment becomes particularly urgent. In territories under constant shelling, universities become not only centers of knowledge but also hubs of resilience, building societal trust in Ukrainian education, ensuring the restoration of human capital, and strengthening regional identity.

Relevance to the specified area of the competition consists in the practical implementation of innovative solutions within the internal quality assurance system for educational activities. The National Aerospace University "Kharkiv Aviation Institute" (hereinafter – "KhAI") demonstrates an example of transforming the educational-regional trajectory amid military threats. Educational programs here are not only adapted to international standards and the requirements of the National Agency for Higher Education Quality Assurance, but are also focused on enhancing the resilience of

the educational environment through the adoption of modern digital technologies, quality monitoring systems, and practices of open dialogue with stakeholders.

The purpose of the article. The aim of the study is to theoretically substantiate and develop an integrated model for modernizing educational content and the internal quality assurance system for a higher education institution in a frontline region (using the example of the National Aerospace University "Kharkiv Aviation Institute"). This model is intended as a tool for resilience, the preservation of knowledge centers, and an alternative to relocation. The study also aims to empirically demonstrate the model's effectiveness and scalability.

Literature review. During the preparation of this study, a set of methods was employed to ensure the scientific validity, reliability, and practical significance of the results: Analysis and synthesis of the legal framework – This involved examining the current legislation of Ukraine in the field of education (Laws "On Education," "On Higher Education"), the standards and recommendations of the NAQA (National Agency for Higher Education Quality Assurance), as well as regional programs (such as "Education of the Unbreakable Kharkiv Region" 2024–2028). This made it possible to identify the key requirements for the internal education quality assurance system and to define areas for its modernization. Comparative analysis of international experience – Ukrainian practices in education quality assurance were compared with approaches used in countries experienced in preserving education during military conflicts (Israel, the Balkan countries, Georgia). This provided an opportunity to outline the strengths and risks of various strategies and to confirm the relevance of the chosen educational-regional trajectory for KhAI. Case study of the National Aerospace University "KhAI" – The university's practical steps were analyzed, including the implementation of hybrid learning models, the arrangement of safe shelters, content digitalization, mechanisms for academic integrity, and international integration. This allowed for an examination of the specific internal innovations within the education quality system under the unique conditions of a frontline region. Statistical analysis – Official data from the Ministry of Social Policy of Ukraine on the number of internally displaced persons (IDPs) in the Kharkiv region were used, along with statistics from the Ministry of Education and Science of Ukraine and indicators of the university's participation in international rankings. The application of this method made it possible to support the conclusions with specific facts and quantitative characteristics. Systems approach – This ensured a holistic understanding of the problem by integrating different levels of analysis: from local (university) practices to national strategies and international trends. The use of these methods made it possible to substantiate the educational-regional trajectory as an effective mechanism for preserving knowledge centers, to confirm the innovative nature of KhAI's activities in internal education quality assurance, and to demonstrate the practical value of the results obtained.

Main results of the research. The full-scale war has created unprecedented threats to Ukraine's education system. In modern times, armed conflicts remain a common occurrence, despite the global efforts undertaken by the international community to peacefully resolve international disputes and prevent conflicts from escalating to military stages. The devaluation of knowledge centers located in frontline regions, which endure daily shelling, has become particularly palpable. Material damage from the destruction of buildings, equipment, and infrastructure is compounded by an even more serious loss: the risk of losing human capital. Faculty and students are forced to evacuate to safer regions or abroad, creating the danger of an "educational outflow" (brain drain) and the fragmentation of the academic community. Under these conditions, preserving universities in frontline regions as strategic hubs for national recovery is critically important. Educational institutions ensure not only the transmission of knowledge but also the cultivation of values such as resilience, responsibility, and patriotism. They remain hubs for the development of science, culture, and innovation, without which the state's full recovery after the war is impossible. Universities in frontline regions play an exceptional role in maintaining social unity and national recovery. Amid constant security threats, they become not only educational institutions but also symbols of state presence, reinforcing citizens' trust in Ukrainian education and fostering strategic hope for the future.

From the first hours of the full-scale invasion, Kharkiv found itself on the front line. What transpired in the city and its surroundings needs no further reminder. Yet, despite relentless air alarms, periodic shelling, and damage to critical infrastructure, the residents of Kharkiv continue to work, ensuring and implementing the right of children to education. The National Aerospace University

"Kharkiv Aviation Institute" (KhAI) is an example of an institution that continues to operate under extremely difficult conditions. Despite daily security challenges, the university maintains the integrity of its educational process, supports research activities, and demonstrates a model of resilience to society. As a result, KhAI serves not only as an educational institution but also as an example of a resilient educational institution in the region, proving that even amid war, Ukrainian education is capable of modernizing, developing, and fulfilling its strategic mission. Even during the spring and summer of 2022, NAU "KhAI" did not leave the city, remaining an educational and research institution.

The Kharkiv Aviation Institute has a specific educational-regional mission, which involves the integration of three key functions (Fig. 1).

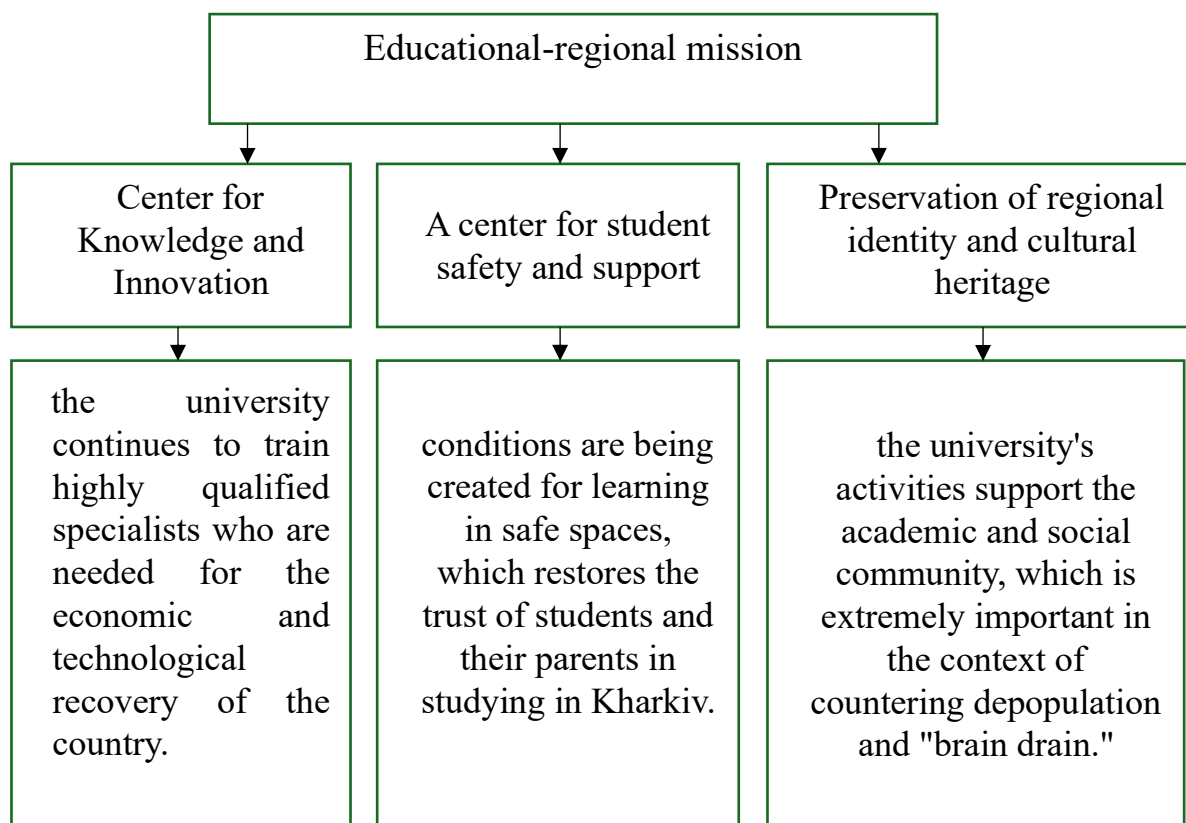


Fig. 1. Functional components of the educational-regional mission of KhAI

As seen in Fig. 1, the practical significance of this mission is that KhAI not only ensures the continuity of the educational process but also fulfills a strategic role in preserving the scientific and educational potential of the Sloboda region (Slobozhanshchyna). It is thanks to its activities that Kharkiv retains its status as one of Ukraine's key educational centers, despite the danger that constantly accompanies the city's life. KhAI's educational-regional mission is not just a local but also a national priority, as the preservation of the university in a frontline region guarantees the future recovery of both the regional economy and the state as a whole.

The current realities of the Kharkiv region, the permanent threats, and risks shape the vector for prioritizing the issues of securing the educational-regional trajectory and forming a system for preserving the existing hubs of the Ukrainian educational and scientific environment.

It is natural that Kharkiv holds the status of "Student Capital," a result formed over centuries, and Kharkiv itself was and remains a key center for the region's scientific development, including its technical, humanitarian, and science-intensive sectors. Kharkiv is one of the few cities that possesses a unique "education-business-community" complex. The city's developmental achievements are a natural outcome of the functioning of this interconnection, which yields a synergistic (additional) result not only for the region but for the performance of the entire country. The elimination of any link in this chain threatens a fundamental change in production quality standards, capacities, and, overall, the lives of its residents, destroying the possibility of rapid recovery. Neglecting support for

these local drivers of development (education-business-community) creates an additional socio-economic burden on the state sector for subsidies and grants.

However, despite the extremely difficult situation, the educational process continues in the Kharkiv region. Under extremely challenging conditions, Kharkiv's education system is developing: the results shown by graduates of higher education institutions in intellectual contests, tournaments, and competitions testify to the high effectiveness of scientific and pedagogical work, even in difficult wartime conditions.

It should be noted that the problem of preserving educational potential in a warzone is a focus of attention for international organizations. For example, the UNESCO Report "Education under Attack 2022" emphasizes that Ukraine has become one of the most affected countries, where educational institutions systematically suffer from military actions, and universities in frontline regions bear a double burden—infrastructure destruction and the outflow of scientific and pedagogical staff. According to the Ministry of Education and Science of Ukraine, as of early 2024, over 3,000 educational institutions of various levels had been damaged or destroyed, creating an unprecedented challenge for the restoration of the educational network.

Additionally, the World Bank, in its "Ukraine Rapid Damage and Needs Assessment" report (2023), notes that direct losses to the education sector exceeded 9 billion USD, and that rebuilding the system will require a comprehensive approach emphasizing resilience and digitalization. Furthermore, the UN (UNICEF, 2023) highlights that over 5.3 million children and youth in Ukraine have experienced disruptions to their education, jeopardizing the formation of human capital at the national level.

KhAI's experience demonstrates that even under constant threats, it is possible to ensure the continuity of the educational process and fulfill the function of a regional recovery hub. This model is the basis for forming the concept of Ukraine's educational resilience, which must consider the specifics of regional challenges, the risks of human capital loss, and the need for rapid modernization of educational infrastructure.

The KhAI university community, working under constant security threats, realizes that traditional mechanisms for education quality assurance require significant renewal. The response to these challenges has been the implementation of a set of innovations aimed at guaranteeing the continuity of the educational process, increasing its effectiveness, and preserving the trust of students and society in the educational environment.

Among the leading innovations is the introduction of blended educational technologies, based on combining traditional classroom learning with digital platforms and remote teaching methods. The biggest innovation in wartime has been the implementation of hybrid and blended learning formats, which allow for the combination of offline and online classes. For KhAI, this approach became the foundation for preserving the educational process, as it allows for rapid format changes depending on the threat level. Its practical significance is that students can safely continue their studies while in shelters or even outside the region, and instructors receive tools to adapt courses for different scenarios. This model ensures mobility, resilience, and psychological comfort for all participants in the process.

The integration of safe educational spaces (shelters equipped for learning) is considered a component of the internal education quality assurance system, as it creates conditions for the continuity of the educational process even in threatening circumstances. KhAI has paid special attention to the creation of safe spaces for learning. The university is implementing projects to equip modern shelters that perform a dual function: they provide physical protection for students and are simultaneously equipped for conducting classes. The use of multimedia equipment, internet access, and interactive platforms in such spaces allows for the organization of an uninterrupted educational process even during air alarms. This innovation forms a unique practice of "safe education," guaranteeing students the right to knowledge regardless of the circumstances. For instructors, this means the ability not to lose the educational rhythm, and for the university—a confirmation of its high level of responsibility towards its students and society. It should be emphasized that the equipping of safe shelters at KhAI is considered not just a requirement of the times, but as a component of the internal education quality assurance system. After all, the quality of education today cannot be separated from the creation of a safe environment for students and faculty. The integration

of shelters into the educational process—with modern multimedia equipment, internet access, and the possibility of conducting classes in a hybrid format—guarantees the continuity of learning even during prolonged air alarms.

In parallel with the development of shelters and hybrid formats, digitalization is actively advancing at KhAI. The digitalization of educational content and the implementation of systemic monitoring of learning quality are becoming key tools for ensuring educational resilience. They not only allow for the adaptation of educational materials to distance or blended formats but also create a foundation for the objective assessment of learning outcomes. The university is creating electronic platforms for accessing educational materials, organizing distance courses, and collecting feedback. Electronic monitoring systems make it possible to track students' academic results, quickly identify problematic areas, and increase teaching effectiveness.

In conditions of societal instability, building trust in the education system takes on special significance. Academic integrity and the transparency of the educational process are becoming key principles for maintaining trust in university education. Adherence to the principles of integrity amid military challenges ensures the legitimacy of learning outcomes and the integration of Ukrainian higher education institutions into the European educational space. KhAI is implementing practices of public reporting, conducting regular student surveys, and actively involving student self-government bodies in managerial decision-making. This promotes the formation of an integrity culture, increases student motivation, and creates an atmosphere of responsibility within the academic community.

External validation of education quality is extremely important for KhAI. International integration and participation in global university rankings serve as important indicators of the resilience of higher education institutions. The university is actively integrating into the international educational space, participating in global rankings, and expanding partnerships. This not only increases the institution's competitiveness but also opens new opportunities for academic mobility for students and faculty. Participation in international projects and programs serves as confirmation that even under difficult conditions, KhAI remains part of the European and global educational space.

At the national level, issues of educational resilience are also enshrined in relevant strategic documents. For instance, at a plenary session of the Kharkiv Regional Council, deputies approved the Education Development Program "Education of the Unbreakable Kharkiv Region" for 2024–2028, which, in particular, provides for: the preservation and restoration of damaged and destroyed educational institutions in the region; the creation of favorable learning conditions for children; support for gifted and talented children and youth; and the incentivization of pedagogical work. It is precisely the modernization of curricula at KhAI that has become an important tool for increasing the resilience of the university and the entire educational system (Fig. 2).

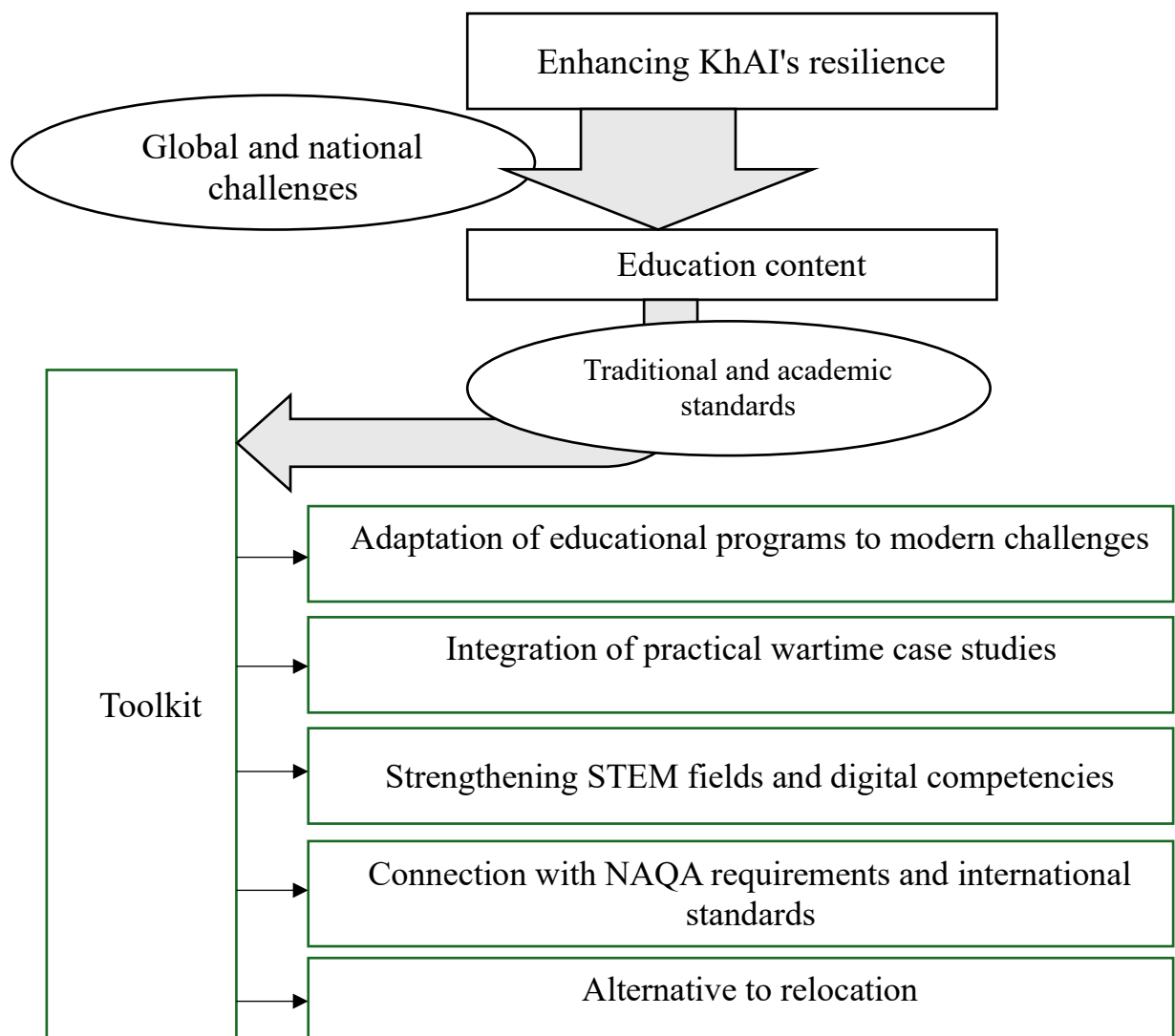


Fig. 2. Toolkit for enhancing KhAI's resilience

Figure 2 illustrates the logic of building the university's resilience: global and national challenges necessitate the modernization of educational content, which combines traditional academic standards with innovative tools. The latter include adapting programs to modern conditions, integrating practical wartime case studies, strengthening STEM fields and digital competencies, compliance with NAQA requirements and international standards, and serving as a strategic alternative to relocation. It is these tools that enhance KhAI's resilience and the competitiveness of its educational environment.

Disciplines aimed at developing competencies in risk management, crisis management, cybersecurity, and economic and energy security are integrated into course content. The practical significance of these changes is that graduates receive not only specialized knowledge in their professional fields but also universal skills necessary for working in conditions of instability and rapid transformations.

The modernized curricula involve the use of real-world examples that reflect the current experiences of the economy, business, public administration, and the defense sector operating under wartime conditions. This allows students not only to master theoretical material but also to see the direct connection between knowledge and practice. This approach fosters the development of critical thinking, the ability to make decisions in crisis situations, and the capacity to act in conditions of high uncertainty.

The university is focusing on the development of STEM education, which corresponds to both global trends and national needs. A special emphasis is placed on digital technologies, artificial intelligence, automation systems, and engineering innovations. At the same time, students gain access

to digital laboratories and simulation platforms, which allows them to practice skills in virtual environments and ensures the continuity of learning even while in shelters.

The modernization of educational content is carried out in strict accordance with the national accreditation standards set forth by the National Agency for Higher Education Quality Assurance. Simultaneously, the university aligns with international qualifications frameworks and standards, which ensures the compatibility of KhAI diplomas with the European Higher Education Area. The practical effect is the opportunity for academic mobility for students and faculty, as well as the enhanced competitiveness of graduates in the global labor market.

The modernization of educational content at KhAI has become a response to discussions regarding the expediency of relocating universities from frontline regions. While relocation often leads to the loss of academic schools, student communities, and socio-cultural potential, the adaptation of programs and the development of the educational-regional trajectory allow the university to remain in its city, fulfilling its role as a hub of knowledge and resilience. Thus, educational content becomes not only an academic tool but also a strategic resource for national security.

The simplest approach in difficult conditions is simple relocation – moving to safer regions. Relocation may result in staff layoffs and a general deterioration of the local community's economic standing, which will place an additional burden (both economic and social) on state institutions. The discussion regarding the advisability of relocating universities from front-line regions requires an objective analysis of its consequences compared to an alternative educational-regional strategy. To systematize the arguments, a comparative analysis was conducted, which is summarized in the table.

Table 1.

Criterial comparison of relocation and the university's educational-regional strategy

| Criterion | University relocation | Educational-regional strategy |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Sociocultural aspect | Loss of historical and cultural heritage, disconnection from the region's academic community. | Preservation of scientific schools, cultural identity, and student communities. |
| Educational and scientific potential | Risk of losing students and faculty, decreased competitiveness. | Support for personnel potential, development of local research initiatives. |
| Finances and infrastructure | Significant additional state expenditures on relocation, rent, and equipping new facilities. | Utilization of existing infrastructure, investment in restoration and modernization. |
| Local development | Weakening of the regional economy due to the loss of jobs and student flows. | Support for the local economy, collaboration with communities and business. |
| Quality of education | Risk of lowered standards due to a lack of resources and adaptation difficulties. | Quality assurance through hybrid models, digitalization, and safe learning environments. |
| Strategic perspective | A short-term solution that could lead to the institution's disappearance from the country's educational map. | A long-term strategy for development and resilience that promotes the recovery of the region and the state. |

As the comparison shows, relocation has short-term effects but is accompanied by significant losses of sociocultural, educational, and economic potential. Conversely, the educational-regional strategy ensures the preservation of scientific schools, support for local communities, and the formation of resilience within the educational environment. These findings can serve as a basis for state strategies on optimizing the network of higher education institutions, prioritizing the preservation of regional knowledge centers and their modernization, rather than mechanical relocation. Considering these risks is a crucial step when deciding on the relocation of a higher education institution and ensuring that the advantages outweigh the consequences.

A strategy of developing the university within its own sociocultural environment is more effective and promising than the relocation model. Thus, modernization steps in education serve not only as tools for quality assurance but also as a strategic resource for national security and state recovery. Further research into the effects of implemented innovations and an assessment of their scalability at both regional and national levels are essential. The implementation of innovative solutions in the education quality assurance system and the modernization of educational program content at KhAI have yielded comprehensive results, evident both within the university community and in the broader regional and national contexts. The summarized effects of these changes are shown in Figure 3.

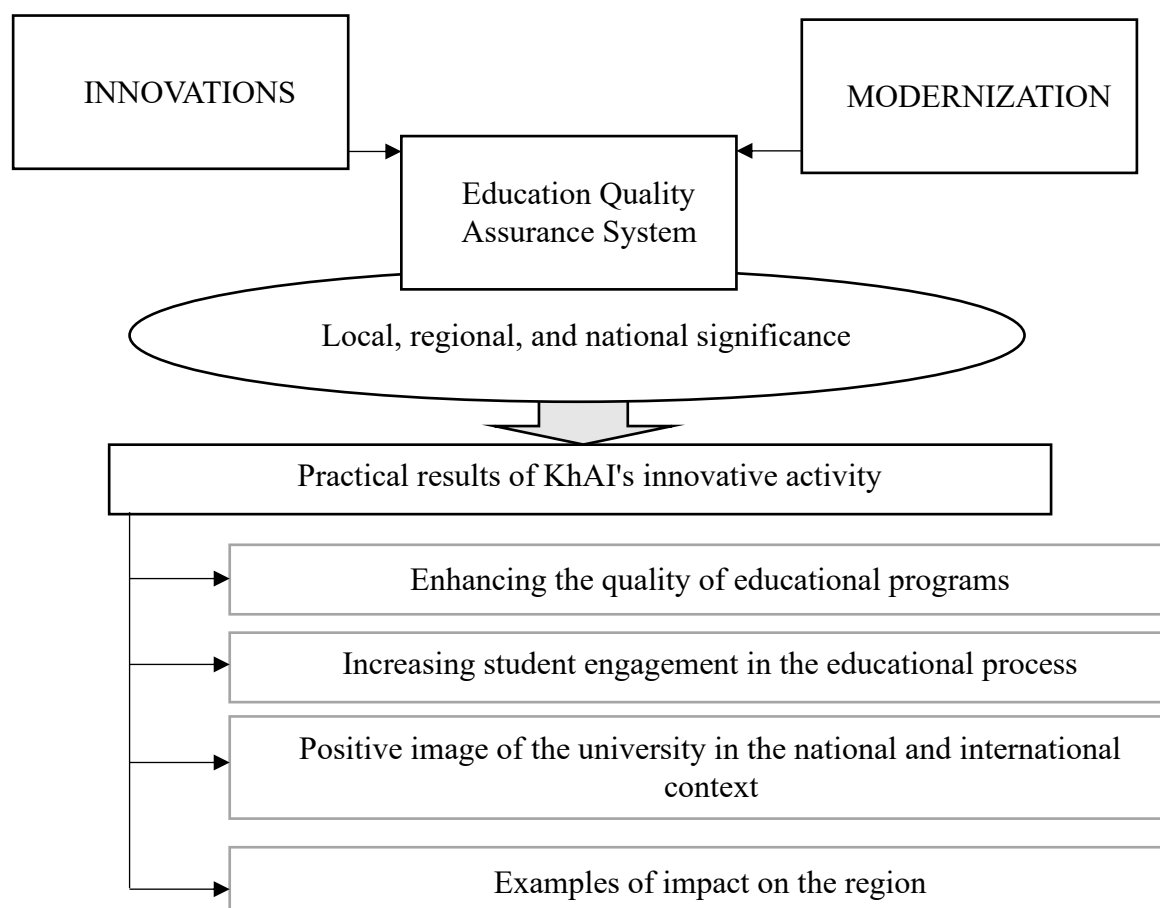


Figure 3. Practical effects of the integration of innovative and modernization approaches into KhAI's education quality assurance system

As seen in Figure 3, the introduction of innovations into the internal education quality assurance system and the updating of educational program content at KhAI create multilevel effects spanning academic, organizational, sociocultural, and strategic dimensions. These results confirm that the university has not only maintained functionality amid wartime challenges but has also managed to strengthen its competitiveness. A further detailed examination of these effects allows for a clearer definition of their significance for local, regional, and national development.

Adapting curricula to modern challenges, integrating digital technologies, and combining classical academic traditions with practical wartime case studies have significantly strengthened the applied component of student training. As a result, the university's educational programs are becoming more competitive and meet the requirements of both the National Agency for Higher Education Quality Assurance and international standards.

The introduction of hybrid formats, access to electronic platforms, and the participation of student self-government in managing the educational environment have enhanced the interactivity of learning. Students not only acquire knowledge but also actively influence its quality through feedback mechanisms. This fosters a sense of responsibility for their own educational path and increases their motivation to learn.

Through active participation in global ranking systems, implementation of international projects, and mobility programs, KhAI is strengthening its presence in the global educational space. Concurrently, the national level of trust in the university is growing due to the demonstration of its resilience in the face of wartime challenges. KhAI is perceived as an institution that has not only preserved its operations but also modernized them, becoming an example for other universities in Ukraine.

The development of the educational-regional trajectory is manifested in several areas: attracting applicants from Kharkivshchyna and other regions by creating safe learning environments; collaborating with communities by participating in regional educational programs aimed at infrastructure restoration and youth support; international projects that allow attracting investments into the development of university science, exchanging experience, and improving the quality of personnel training. Thus, the practical results of KhAI's innovative activities indicate that the university has become not only a place for acquiring knowledge but also an important factor in the region's socio-economic resilience and Ukraine's positive image on the international stage.

First and foremost, there should be well-founded research into the causes of the depressive state of the higher education system in the regions, because the belief that simply moving or merging entities can remedy or revitalize regional education might be an illusion. The reasons for the system's depression are much deeper than just an "unoptimized network." And it is already clear that no reforms in line with the Bologna system, no quality assurance, no updated standards, no new qualifications frameworks, no friendships with stakeholders, etc., have revitalized the system.

The integrated model for modernizing education content and HEI resilience (Figure 4) summarizes the results of the innovations implemented at KhAI and demonstrates the interrelationship between input factors, key transformation modules, resource support elements, and achieved outcomes. Its construction allows not only for a structured presentation of the logic of the changes but also reveals the scientific novelty in forming the concept of an "educational-regional trajectory" as an alternative to relocating universities in front-line regions.

The model aims to transform a university in a front-line region into a "center of resilience and knowledge," where the modernization of education content and the internal quality system ensure continuity, trust, and competitiveness.

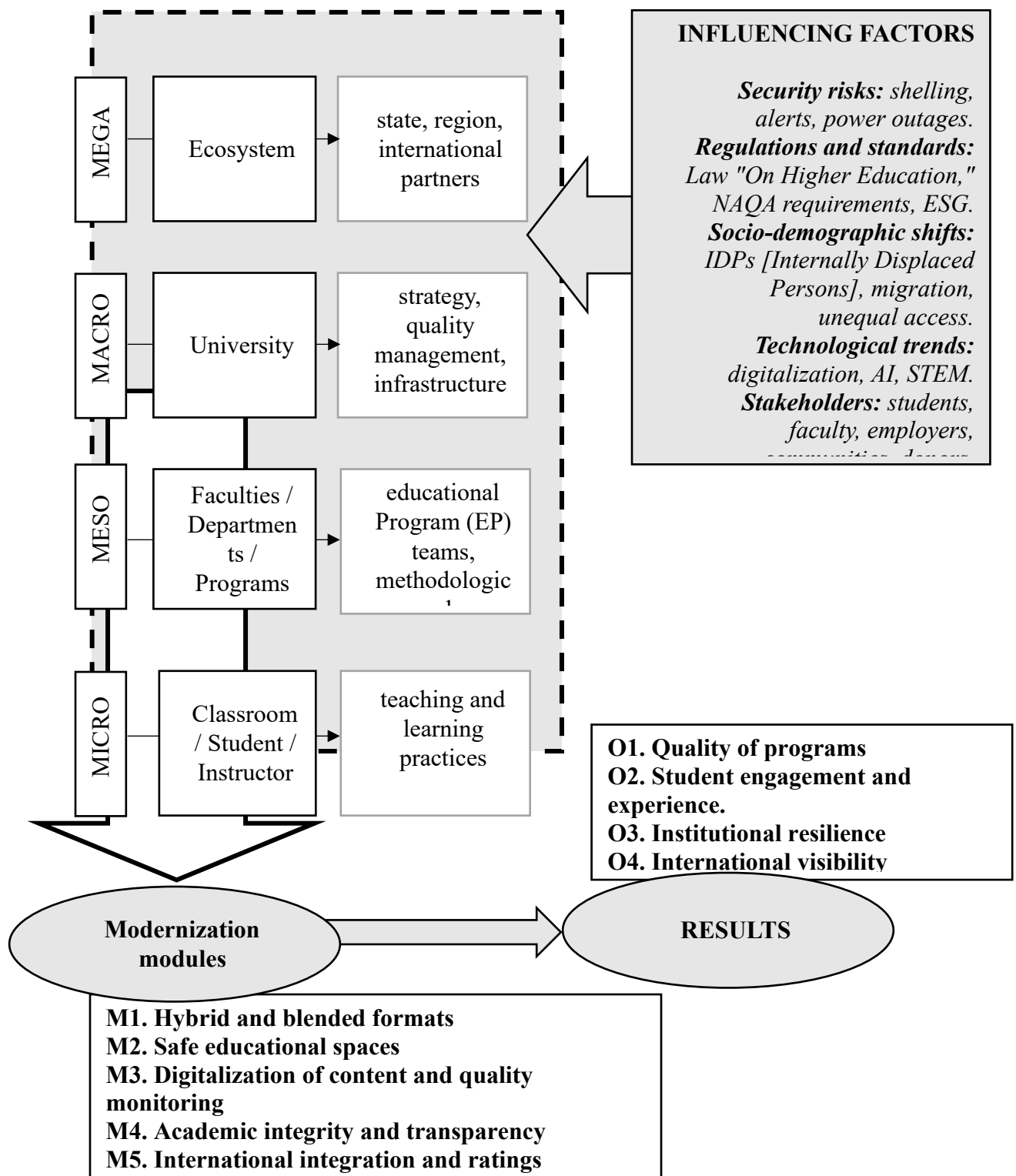


Figure 4. Integrated model of education content modernization and HEI resilience (on the example of KhAI)

The proposed model involves a multi-level organization of modernization processes, encompassing the MEGA-level (state policy, international partners), MACRO-level (the university as an institution), MESO-level (departments, educational programs), and MICRO-level (faculty and students). This multi-level structure makes it possible to integrate local educational practices into the broader regional and national context.

At the core of the model are five modernization modules (M1–M5), reflecting the key areas of internal transformation: from the implementation of hybrid formats and the development of safe educational spaces to digitalization, the affirmation of academic integrity, and the expansion of

international integration. All modules are supported by resource enablers—management and financial mechanisms, human capital development, digital infrastructure, and communication channels with stakeholders.

The result of this system's operation is the formation of Outputs, which manifest in four dimensions:

1. enhanced quality of educational programs and their compliance with international standards;
2. increased levels of student engagement;
3. ensuring the university's institutional resilience under conditions of constant risk;
4. strengthening the institution's international visibility and reputation.

The final block is the outcome, reflecting the model's strategic impacts: the retention of human capital in the region, support for the local economy, the formation of a positive international image for Ukraine, and the creation of a sustainable alternative to university relocation.

An important element is the feedback system: student feedback and external international validation. This ensures continuous improvement, adaptation to dynamic conditions, and increased effectiveness of internal transformations.

The scientific novelty lies in the conceptualization of the "safe education" model and the introduction of the category "educational-regional trajectory" as a strategic tool for preserving knowledge centers in front-line regions. Unlike approaches based on simple university relocation, the proposed model demonstrates that through the integration of hybrid formats, shelters as learning spaces, digital monitoring systems, and international validation, it is possible not only to maintain the institution's functionality but also to ensure its development.

The implementation of the model at KhAI has made it possible to:

1. ensure the continuity of the educational process, even during periods of active shelling;
2. increase the trust of students and their families in studying in a front-line region;
3. preserve scientific and pedagogical schools and prevent "educational outflow";
4. integrate the university into the international educational space despite the wartime risks.

, the model has both theoretical significance (developing the new concept of the educational-regional trajectory) and practical value (creating a universal framework for modernizing education content for universities operating in crisis and high-risk environments).

The results of implementing innovations and modernization processes at KhAI demonstrate that the university can act not only as an educational hub but also as a strategic factor for the region's social and economic resilience. Preserving universities in front-line regions is a matter not only of academic expediency but also of national security and state recovery. The educational-regional strategy, unlike the relocation model, ensures the preservation of scientific schools, cultural heritage, and personnel potential, while simultaneously creating a foundation for future development. Supporting regional universities must be considered a state policy priority, as they are the ones that build the human capital capable of ensuring Ukraine's recovery, its competitiveness, and its integration into the European educational space.

Conclusions. The results of the implemented changes confirm the effectiveness of the chosen trajectory. KhAI has ensured an increase in the quality of its educational programs, expanded opportunities for students to participate in shaping the educational environment, and formed a positive image in the national and international context. At the same time, the university has a tangible impact on the region's development by attracting applicants, cooperating with communities, and participating in international projects. Overall, KhAI's activities confirm that education is a key factor in society's resilience and the state's recovery. The modernization of education content and the introduction of innovations into the internal quality assurance system enable universities in front-line regions not only to endure but also to develop, securing a future for hundreds of thousands of young people.

Recommendations for the state. The obtained results indicate the need to form, at the state policy level, specific support mechanisms for universities operating in front-line regions. It is advisable to develop targeted funding programs for safe educational spaces, digital infrastructure, and the stimulation of scientific activity as a key factor in enhancing the education system's resilience.

Recommendations for universities. Higher education institutions in Ukraine can use KhAI's experience as a model for implementing innovations into their internal education quality assurance systems. Practices such as hybrid learning, digitalization, creating shelters for classes, and involving

student self-government in management processes should be integrated into university development strategies, even outside of combat zones.

Recommendations for international partners. KhAI's experience demonstrates that Ukrainian universities are capable not only of preserving the educational process in crisis conditions but also of implementing unique innovative solutions. This creates a foundation for expanding international projects and support programs aimed at developing educational resilience, academic mobility, and Ukraine's integration into the global educational space.

Compliance with the competition's focus. The solutions proposed in this work directly relate to the introduction of innovations into the internal quality assurance system for educational activities: from hybrid learning models and digital monitoring to creating safe learning environments and strengthening academic integrity. This confirms that the work fully meets the requirements of the nomination "Modernization of education content in the context of global and national challenges." KhAI's experience holds not only local but also national significance. The introduced innovative practices—equipping safe shelters as learning spaces, implementing hybrid learning models, digital quality monitoring, and strengthening academic integrity—can be adapted by other universities in Ukraine, particularly those located in high-risk or resource-limited conditions. Scaling these solutions will enhance the resilience of the entire higher education system, ensure its compliance with international standards, and strengthen Ukraine's competitiveness in the global educational space. KhAI's educational-regional trajectory is an effective mechanism for overcoming the devaluation of knowledge centers, improving the quality of the educational process, and forming a competitive educational environment. This experience serves as a universal model that can become the basis for state policy in preserving and modernizing education in crisis conditions.

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