

DOI: 10.32703/2617-9059-2024-44-5

UDC 377.3:331.556(477):355.01

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### **Migration and evolutionary analysis of trends in the transformation of maritime education in wartime conditions**

*The research focuses on analyzing fundamental changes in Ukraine's higher education system occurring under the influence of unprecedented geopolitical events and demographic shifts, with particular emphasis on the maritime education sector. The study examines the period of 2020-2023, characterized by large-scale challenges caused by Russian military aggression and its consequences for the educational sector. Based on the analysis of institutional reports and statistical data, significant changes have been identified in student contingent dynamics, redistribution of educational flows, and transformation of educational practices. The research results demonstrate that despite considerable adaptability and successful implementation of European educational standards, Ukraine's higher education system has faced serious challenges related to forced youth migration and demographic decline. This problem is particularly acute in the maritime education sector, where there is a persistent trend toward decreasing numbers of students. The paper substantiates the necessity of systematic state measures for developing maritime education in Ukraine. The research reveals the complex interaction between demographic trends, educational transformation, and sectoral development under wartime conditions.*

**Keywords:** adult higher education; Education during the war, Maritime Education and Training, competitiveness of education, educational migration, MET.

**Introduction.** With the onset of the armed conflict in Ukraine, more than two million children were forced to leave their homes, becoming internally or externally displaced persons, which triggered a large-scale humanitarian crisis and affected the sustainability of the educational process. Military actions not only exacerbated the existing challenges caused by the COVID-19 pandemic but also led to reduced government spending on higher education, fewer state-funded positions in universities, and decreased household income levels. These factors significantly impacted the accessibility and competitiveness of domestic education.

Against the backdrop of these circumstances, students and faculty members found themselves in various situations: some students left the country, others remained in temporarily occupied territories or were subjected to shelling, some became internally displaced persons, while others experienced virtually unchanged living and learning conditions. University teaching staff also face significant challenges, including forced remote teaching and decreased stability in working conditions. The combination of these factors may lead to a substantial decrease in demand for national higher education, particularly among youth oriented toward international opportunities.

However, despite the negative consequences, the war has become a catalyst for long-awaited transformations in the education system, including the active development of digital and distance learning. The transition to digital formats, which began with the pandemic, has now become the primary

means of ensuring educational continuity. Furthermore, under these conditions, the importance of integrating Ukrainian universities into the international educational community and creating joint programs with foreign universities has increased, contributing to the enhanced competitiveness of Ukraine's higher education.

The prospects for transforming Ukrainian higher education extend beyond digitalization and distance learning. It is important to consider directions for strengthening international partnerships, implementing hybrid educational models, and developing educational programs adapted to changing socio-economic conditions.

**Analysis of recent research and problem statement.** Education has always been an important instrument for society's development, the foundation of cultural and economic progress, and a crucial factor in unlocking human potential. However, today Ukraine's educational system is affected by a range of negative factors, among which the consequences of the war, which has directly impacted every sphere of the country's life, should be primarily highlighted. Large-scale forced population displacement, destruction and damage to educational institutions, as well as limited access to educational resources are just some of the problems that have resulted from military actions.

The full-scale invasion of Russian forces into Ukrainian territory on February 24, 2022, not only directly impacted Ukraine's higher education system but also caused significant changes in the national systems of the EU and other civilized countries. From the first days of the war, Ukrainian universities found themselves under attack by Russian forces. By the summer of 2022, analysts from the Kyiv School of Economics reported that Russian troops had completely destroyed four higher education institutions, while nearly fifty others had been damaged. While these figures may seem less significant compared to the destruction of schools and kindergartens, in percentage terms, almost 20% of universities and institutions of professional pre-higher education were either destroyed or severely damaged.

According to data from the State Statistics Service of Ukraine, in 2021 there were 281 higher education institutions in the country, including universities, institutes, and academies, as well as 234 state-owned colleges. A total of 964,500 students were enrolled in universities, the majority of whom were pursuing bachelor's and master's degrees. Additionally, 25,600 individuals were pursuing doctoral degrees. Ukrainian higher education institutions employed 135,200 staff members, and 67,300 international students were enrolled.

According to the United Nations, as of October 2022, 7.6 million Ukrainian refugees were in other European countries, with 4.2 million registering for temporary shelter or participating in national assistance programs for Ukrainians. As a result of the Russian invasion, Ukraine experienced one of the largest displacements of people in history, with nearly 14 million people forced to leave their homes due to the ongoing conflict.

To date, over 10 million Ukrainian citizens have been forced to leave their homes due to shelling and the threat to their lives, causing a humanitarian crisis both within the country and beyond its borders. Approximately 2,000 educational institutions have been damaged due to bombings, a significant portion of which are beyond repair. Some universities and other educational institutions have been forced to relocate their campuses to safer regions, further complicating the educational process [1].

Moreover, the war has disrupted international student mobility and educational migration, significantly hindering access to quality education for both Ukrainian citizens and international students. The loss of access to educational resources and security has become a major issue, complicating the pursuit of quality education not only for Ukrainian citizens but also for foreign students who sought to study at Ukrainian institutions. The lack of stable conditions for studying and working in wartime has led to significant changes in the educational systems of

other countries, where Ukrainian students have sought refuge and continued their studies. This has necessitated the adaptation of educational systems to new realities, including flexibility in delivering education, supporting distance learning, and developing international educational programs to restore academic mobility once the conflict is over.

During this challenging period, it is important to remember that the problem is not limited to just physical destruction of educational institutions. Significant difficulties have also arisen due to challenges that emerged even before the COVID-19 pandemic and have become more pressing under wartime conditions. Issues such as education funding, reduction in state-funded positions in higher education institutions, declining household incomes, and intensification of educational migration processes have placed additional strain on Ukraine's educational system. The demand for domestic education is decreasing, which is an alarming signal for the future.

According to the Strategy for Higher Education Development in Ukraine for 2021-2031, the main problem of the educational system is its lack of demand in Ukrainian society, which, combined with the massification of education, creates distortions in the educational process. Under these conditions, the war has become a catalyst for necessary changes, particularly in the direction of digitalization and distance education, which maintains access to learning even under physical and logistical constraints.

At the same time, despite serious difficulties, the Ukrainian state continues to follow the defined direction of higher education reform aimed at integration into the European and global educational community. Progressive legislative initiatives, such as the national "Education" program, the Law of Ukraine "On Higher Education," and the Presidential Decree "On the Main Directions of Higher Education Reform in Ukraine," should become the foundation for building next-generation education capable of withstanding modern challenges and becoming competitive at the international level.

To implement this strategic vision, united efforts of government bodies, universities, businesses, the scientific community, and the public are necessary [2]. An innovative approach to development, based on the active use of scientific knowledge, achievements, and support for innovative activities, becomes particularly important.

Given a number of global challenges, the higher education system in Ukraine requires a deep rethinking of its role and objectives. Training specialists capable of acting in conditions of rapid change, addressing sustainable development issues, and maintaining harmony between humans and nature should become a key priority.

The reform of Ukrainian higher education aligns with global trends such as standardization, focus on core disciplines, implementation of modern management, and increased university accountability for education quality. Overcoming existing problems and implementing the strategy for higher education development is a crucial task that determines Ukraine's future.

Recognized Western researchers of educational systems emphasize the necessity for deep and decisive transformations in higher education. They warn that without decisive changes, higher education may remain within a conservative approach, limited to only local innovations. Conservative models that dominated in the second half of the 20th century no longer meet modern needs.

Since independence, the Ukrainian higher education system has undergone significant changes, gradually integrating into the global educational and scientific space. The COVID-19 pandemic had a significant impact on this process, accelerating the implementation of distance learning and the transformation of teaching and examination methodologies. The pandemic effectively accelerated higher education's transition from traditional to online formats [3].

However, the connections between Ukrainian higher education and the global system remain insufficiently strong. Even leading Ukrainian universities hold limited positions in world rankings, and the level of scientific productivity and citation rates of their academic staff significantly lag behind those of foreign colleagues. For example, in 2021, only 10 Ukrainian higher education institutions entered the

World University Rankings, occupying positions in the range of 491-819 among 867 universities. The low level of internationalization in Ukrainian higher education and science negatively affects the quality of educational and scientific processes.

At the same time, the global community views higher education as the primary tool for social, cultural, and economic modernization. Therefore, all countries are currently seeking innovative approaches capable of ensuring noticeable progress, as no state is fully satisfied with the condition of its higher education system [4-5].

Given the high competition in the labor market, modern youth must be able to demonstrate necessary knowledge, skills, and competencies. This requires creating an effective mechanism for state regulation of the youth segment of the labor market. Such a mechanism should ensure close cooperation among all stakeholders (public administration bodies, higher education institutions, employers, and youth) in overcoming problems of youth unemployment and professional-qualification imbalances, as well as promote increased youth motivation for highly effective activities.

**The purpose and tasks of the study.** Ukraine has one of the largest maritime industries in the world, and maritime education is critically important for the country's economic growth. Training specialists in the maritime field provides employment opportunities and contributes to logistics development. The maritime education system in Ukraine represents a comprehensive structure that fully complies with international standards, particularly the STCW Convention (Standards of Training, Certification and Watchkeeping for Seafarers) and its Manila Amendments. This regulatory architecture encompasses both international protocols and national legislation, creating a reliable system for training and certification of seafarers.

The regulatory framework has a hierarchical structure, where the STCW Convention and SOLAS (International Convention for the Safety of Life at Sea) form the fundamental international level. These conventions establish basic standards of competency and safety requirements for maritime operations. Particularly important is Ukraine's full implementation of the Manila Amendments to the STCW Code, covering competency standards at both operational and management levels [9].

The national regulatory framework includes several interconnected elements, particularly the Law of Ukraine "On Higher Education" and special ministerial directives regarding maritime education. This legislative foundation is supplemented by industry standards and quality assurance mechanisms. The Ukrainian maritime education system implements a multi-level approach to quality management, including ISO 9001:2015 standards and institution-specific quality management systems.

A distinctive feature of the Ukrainian maritime education system is its comprehensive integration of theoretical learning and practical training. The system takes into account specific requirements of shipowners and recommendations of the International Maritime Organization (IMO), providing graduates with both academic knowledge and practical competencies necessary for the international maritime industry.

Ukraine holds an important position in the global market of maritime professionals, having four leading educational institutions that are members of the International Association of Maritime Universities (IAMU):

- Kherson State Maritime Academy (KSMA), Kherson;
- National University "Odessa Maritime Academy" (NUOMA), Odessa;
- Odessa National Maritime University (ONMU), Odessa;
- Kherson State Maritime Academy (KSMA), Kherson;
- State University of Infrastructure and Technologies (SUIT), Kyiv.

However, the war in Ukraine has become a serious obstacle to providing quality maritime education and cadet training. Educational institutions were forced to switch to an exclusively online learning format, without the possibility of conducting necessary practical training. More than a third of teaching staff found themselves outside Ukraine, and state funding for institutions has been reduced to a critical level.

Despite these challenges, Ukraine remains on the International Maritime Organization's "White List," demonstrating full compliance with the STCW Convention and Code requirements. Ukrainian seafarer

certificates (diplomas) are recognized by 53 IMO member states in accordance with Regulation 1/10 of the STCW Convention. Furthermore, Ukraine's system of seafarer training and certification has been approved by the European Commission following periodic inspections by the European Maritime Safety Agency (EMSA).

According to BIMCO's 2015 maritime workforce report, the number of STCW-certified seafarers available for the international merchant fleet has increased, with growth in both qualified officers and ratings. The number of STCW-certified officers is now estimated at 857,540, representing a 10.8% increase from 2015.

According to data collected from shipping companies, Ukraine ranks among the top five nationalities of STCW-certified seafarers (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers) working in the global merchant fleet.

According to the Seafarer Workforce Report 2021 by BIMCO (Baltic and International Maritime Council), Ukrainian seafarers are represented in all key segments of this market (Tab. 1)

**Tab. 1. Five main nationalities of STCW seafarers as indicated by shipping companies**

	<b>All seafarers</b>	<b>Officers</b>	<b>Ratings</b>
<b>1</b>	Filipino	Filipino	Filipino
<b>2</b>	Chinese	Chinese	Chinese
<b>3</b>	Ukrainian	Ukrainian	Indian
<b>4</b>	Russian	Indian	Ukrainian
<b>5</b>	Indonesian	Russian	Indonesian

The maritime education system in Ukraine demonstrates significant potential for training highly qualified specialists capable of meeting the needs of the modern international shipping industry. Several key advantages of the Ukrainian model of training seafarers and cadets ensure the sustainable competitiveness of its graduates in the global labor market.

First and foremost, it is worth noting the high motivation of Ukrainian citizens to work in officer positions in international shipping. The prestige and promising nature of maritime professions in Ukraine stimulates a significant influx of applicants to specialized educational institutions. This, combined with the institutions' capacity to increase enrollment, creates broad opportunities for training a sufficient number of ship officers.

An additional advantage is the relatively low cost of education, complemented by the opportunity for the best students to receive state funding. Such accessibility of education promotes the attraction of talented youth to the maritime industry, ensuring a stable source of qualified personnel.

Ukrainian universities and academies also demonstrate flexibility and efficiency in their seafarer training and certification system. Specifically, the transition to junior officer status can be achieved within a 4-year educational cycle, accelerating graduates' professional adaptation. An important element is also the involvement of experienced practicing seafarers in teaching activities, ensuring a close connection between theoretical training and maritime practice realities.

Further evidence of the high quality of maritime education in Ukraine is the active support of educational programs by industry companies, particularly through scholarships and other forms of assistance. Such interaction allows alignment of educational program content with current and prospective needs of the shipping industry. Moreover, significant attention is paid to language training and simulator preparation of cadets, ensuring compliance with international standards.

The comprehensive combination of these advantages enables Ukraine to train competitive specialists who are in demand in the global maritime industry. Further improvement of educational standards and teaching methods, along with strengthening industry connections, will contribute to maintaining the leading position of Ukrainian maritime education at the global level [7-8].

The war unfolding in Ukraine presents a serious challenge to ensuring quality training for future maritime professionals. Government restrictions on men's travel have led to significant difficulties for cadets in completing mandatory onboard vessel training. Additionally, logistical complications hinder the timely return of already working students. These factors, along with many cadets' desire to continue

their studies abroad, create serious obstacles for the Maritime Education and Training (MET) system in Ukraine.

Continuous practice on actual vessels is a critically important component of quality maritime specialist training. The inability to complete this practice not only deprives cadets of necessary experience but also threatens the compliance of Ukrainian educational programs with international standards. Alternative forms of practical training, such as the use of simulators and virtual trainers, could help address this problem by partially compensating for the lack of actual onboard practice.

Logistical difficulties related to Ukrainian students' stays abroad also present a serious problem. Delays in returning home not only disrupt the educational process but may also cause students to lose the opportunity to continue their studies. Establishing close coordination between educational institutions, government bodies, and shipping companies to ensure unhindered student movement could serve as an effective solution.

At the same time, the desire of many cadets to continue their studies outside Ukraine is an understandable and justified step. However, excessive outflow of talented youth poses a threat to the future restoration and strengthening of the country's maritime education system. Targeted support programs and scholarships for studying in Ukraine, as well as ensuring employment opportunities for graduates, could help address this issue.

**Materials and methods of research.** Emigration for education is not a new phenomenon. The departure of Ukrainian youth abroad to obtain higher education is a phenomenon with a long history and stable development trends. Before the war in Ukraine, this migration was largely voluntary, massive, and sociocultural in nature, characterized by clearly defined periods of students' stay abroad and their age characteristics.

According to the results of an online survey conducted among students, faculty, and staff of Ukrainian higher education institutions who remained in the country, 97.8% of respondents reported a deterioration in their psycho-emotional state. Complaints of depression were expressed by 84.3%, exhaustion by 86.7%, loneliness by 51.8%, nervousness by 84.4%, and anger by 76.9%. Students, compared to staff, more frequently reported feelings of exhaustion, loneliness, nervousness, and anger, while women more often than men reported depression, exhaustion, loneliness, and nervousness. The authors of the study indicate that respondents who complained of a deterioration in their psycho-emotional state showed higher levels of fear, burnout, and feelings of loneliness, as well as a lower level of resilience [28].

These serious psycho-emotional challenges faced by students and faculty members of Ukrainian higher education institutions may negatively impact not only academic performance but also the overall social climate within these institutions. In such conditions, it is important to pay attention to global trends that could help preserve the intellectual potential of the country and support Ukrainian students and researchers during these difficult times.

Statistical data from the Organisation for Economic Co-operation and Development (OECD) confirm a steady global trend of increasing numbers of international students worldwide. In 1975, their number was 0.8 million, rising to 4.3 million in 2011 and 4.85 million in 2017. It was expected that by 2020 this number would reach 8 million. However, the COVID-19 pandemic introduced some adjustments, but this trend is recovering, opening new opportunities for Ukrainian students, especially those who, due to the war, were forced to seek new ways to pursue education abroad [10].

Among countries that traditionally act as "importers" of educational migrants, highly developed nations with significant scientific potential and leading positions in world university rankings predominate. The world leaders in terms of international student share include the USA, United Kingdom, Australia, France, Germany, and Canada (Tab. 2). The high demand for Ukrainian students in the global educational market is explained by their foreign language proficiency and professional competencies acquired in their homeland.

**Tab. 2. Comparative Analysis of Study Conditions for Ukrainian Students in Countries with High Levels of Academic Support and Accessibility**

Countries	Possibility of free education	Relatively easy-to-learn language	Prospects for obtaining prestigious employment	Affordable cost of education and living	Easy admission requirements to higher education institutions	Study at world-ranked higher education institutions
Poland	+	+	+	+	+	+
Czech Republic	+		+	+	+	
Spain			+	+		
Canada		+	+			+
Italy			+	+		
Austria			+		+	
United Kingdom		+				+
Germany	+		+			+
United States	+	+				+
France			+	+	+	+

The USA and France, along with other countries, view Ukrainian students as desirable migrants due to their language skills and professional competencies. One of the key factors attracting international students is free or affordable education at public universities. Such conditions are offered, in particular, by Poland, Germany, and partially France.

Poland is a popular choice for Ukrainian youth planning to study abroad due to its proximity to Ukraine both territorially and culturally. Poland offers quick adaptation for students, ease of language learning, affordable living and study costs, and the possibility of free education. Recently, Polish universities have intensified their activities in the Ukrainian educational services market. In the context of demographic crisis and youth migration abroad, Poland actively seeks applicants from Ukraine, focusing on geographical, linguistic, and cultural proximity between the countries. For this reason, Poland makes efforts to create attractive conditions for international students, particularly from Ukraine.

The Czech Republic is also one of the leaders among countries offering free education if programs are taught in Czech. Spain attracts students with accessible pathways to professional education and prestigious diplomas. Education in public institutions is inexpensive, and students have opportunities for internships in Spanish companies. Canada attracts youth thanks to its numerous Ukrainian diaspora, which facilitates faster student adaptation. Admission to Canadian universities is possible after completing 11th grade, without mandatory preparatory programs.

Italy is known for its programs in fashion and design. The cost of education here is moderate compared to other European countries, making Italy attractive for many students.

The United Kingdom offers an Online MBA program that allows Ukrainian citizens to study without leaving their country. These students receive textbooks by mail, attend online lectures, and take written examinations. Upon completion of their studies, they receive a British diploma.

An important factor motivating Ukrainian students to pursue higher education abroad is the prospect of obtaining quality employment and permanent residence after graduation [6]. The attractiveness of different countries for Ukrainian youth is determined by various aspects, including study and living conditions. The main motives for educational migration among Ukrainian youth include safe conditions for staying and studying abroad; high-quality education at prestigious institutions; opportunities for obtaining prestigious work and subsequent permanent residence; availability of tuition-free programs; relative ease of admission; affordable study and living costs; and better economic and social conditions.

Current demographic trends in Ukraine show concerning signs of intellectual and physically developed young population outflow to other countries. This process, along with a complex of socio-economic problems, indicates a deep demographic crisis that threatens the national security of the state.

Students abroad most frequently face issues such as financial difficulties, language barriers, challenges in finding employment, unstable mobile and internet connections, limited access to medical services, problems with housing search and payment, as well as psychological issues.

In a fundamentally different situation are the students, teachers, and staff of higher education institutions who remained in Ukraine in the government-controlled territory. Their activities underwent substantial transformation, yet they managed to adapt to the new conditions of the educational process functioning.

The educational process in Ukrainian higher education institutions began to resume from mid-March in remote or blended formats. Despite challenging conditions, higher education institutions demonstrated significant flexibility and adaptability, implementing innovative approaches to organizing the educational process.

Teachers and students face psycho-emotional challenges related to the general situation in the country, yet they have the opportunity to continue the educational process in relatively safe conditions. Higher education institutions are actively implementing technological solutions to ensure quality distance learning, developing new teaching methodologies and knowledge assessment approaches [29].

An important aspect has been the support for students and teachers who were forced to relocate from occupied territories. Ukrainian higher education institutions created conditions for continuing education and work for displaced persons, providing them with necessary resources and support. Educational institutions have also developed mechanisms for recognizing learning outcomes and confirming qualifications of students who previously studied in temporarily occupied territories.

Despite wartime challenges, Ukrainian higher education institutions continue to provide high-quality educational services, maintain international connections, and develop new educational programs. Special attention is paid to preserving the academic community and supporting professional development of teaching staff in remote working conditions.

It is worth noting that higher education institutions in government-controlled territory have become important centers of support and coordination of the educational process for the entire academic community of Ukraine. They not only ensure educational continuity but also contribute to the preservation and development of Ukrainian academic culture under martial law conditions.

The unprecedented challenges facing Ukrainian higher education have catalyzed rapid transformation and adaptation of educational processes, demonstrating the resilience and commitment of the academic community. This transformation encompasses not only technological adaptation but also fundamental changes in educational methodology and institutional support systems, reflecting the sector's capacity for innovation under extreme circumstances.

At least several issues can be identified related to the organization of the educational process in Ukrainian higher education institutions. Firstly, the completion of the 2021/2022 academic year took place under challenging conditions. Although continuity in the educational process was maintained, it required significant effort. The academic year concluded in an accelerated format, particularly for universities that had been relocated or damaged, which imposed additional demands on students, faculty, and administration - especially on graduating students who needed to complete qualification exams and defend their theses.

Secondly, the motivation to teach and learn was significantly affected by the constant state of uncertainty, unstable psycho-emotional environment, and frequent air-raid alerts, with some participants in the educational process facing shelling in active conflict zones. Most surveyed students indicated that it became more difficult to concentrate on their studies; however, the majority also confirmed that they had not lost interest in learning. For faculty and HEI staff, key motivational factors remained their students, a sense of duty and responsibility, and belief in Ukraine's victory.

Third, potential losses in the quality of the educational process should be noted. The period of quarantine restrictions demonstrated that not all institutions managed to implement high-quality distance

learning. This challenge required both technical and pedagogical improvement, and in wartime conditions, this issue has become even more acute.

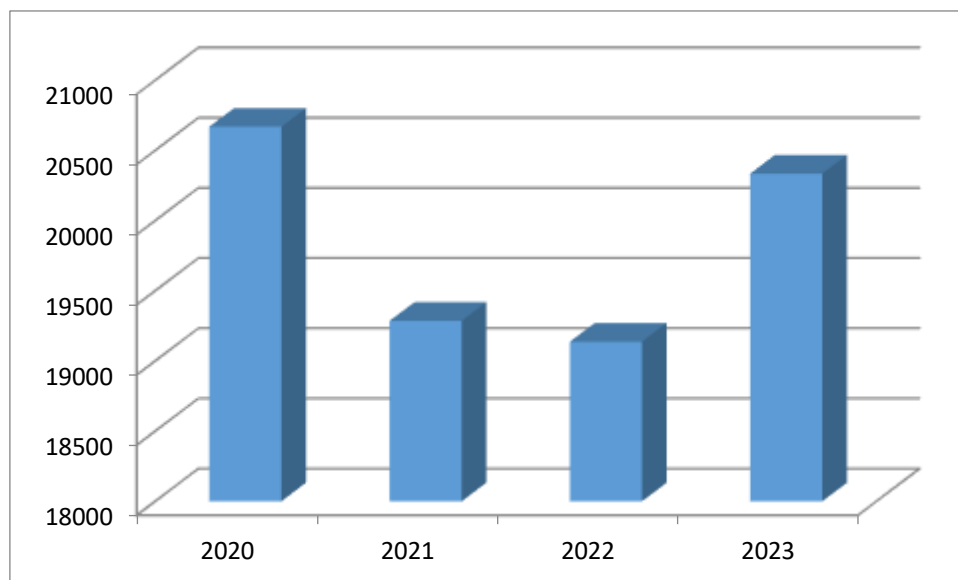
The situation in Ukraine's maritime education system causes particular concern. Analysis of reporting documentation from heads of specialized higher education institutions indicates a steady trend of decreasing student enrollment during 2020-2023. This phenomenon takes on critical significance considering the strategic importance of the maritime sector for the country's economy and its position in the global maritime services market.

Analysis of annual reports [12-27] from maritime higher education institution rectors demonstrates a gradual reduction in the total number of students (Fig. 1).

The data demonstrates a clear downward trajectory in student enrollment from 2020 to 2023, with some recovery in the final year. In 2020, the total student population stood at 21,936, establishing a baseline for comparison. The following year witnessed a modest decline of 3.2%, bringing the total to 21,232 students. This initial decrease, while concerning, remained within manageable parameters.

In 2022, the Ministry of Education and Science of Ukraine attempted to support maritime specialties amid wartime challenges by simplifying the admission process. For certain specialties within maritime higher education institutions, admission to the contract-based form of study was permitted solely based on a motivation letter, aiming to ease access to education. However, despite these efforts, 2022 saw a sharp decline in student numbers, dropping to 19,137 individuals—a significant decrease of 9.9% compared to the previous year. This downturn marked the most pronounced change within the study period and highlights a critical juncture in the demographics of maritime education, one that proved unavoidable despite the measures taken.

Therefore, while policy adjustments such as simplified admissions reflect efforts to mitigate enrollment losses, more comprehensive strategies are required to support the sustainability of maritime education in Ukraine. These might include increased financial aid, mental health support, enhanced digital infrastructure for remote learning, and strong industry partnerships to provide career opportunities for graduates.



**Fig. 1. The dynamics of student enrollment in Ukrainian maritime higher education institutions (2020–2023)**

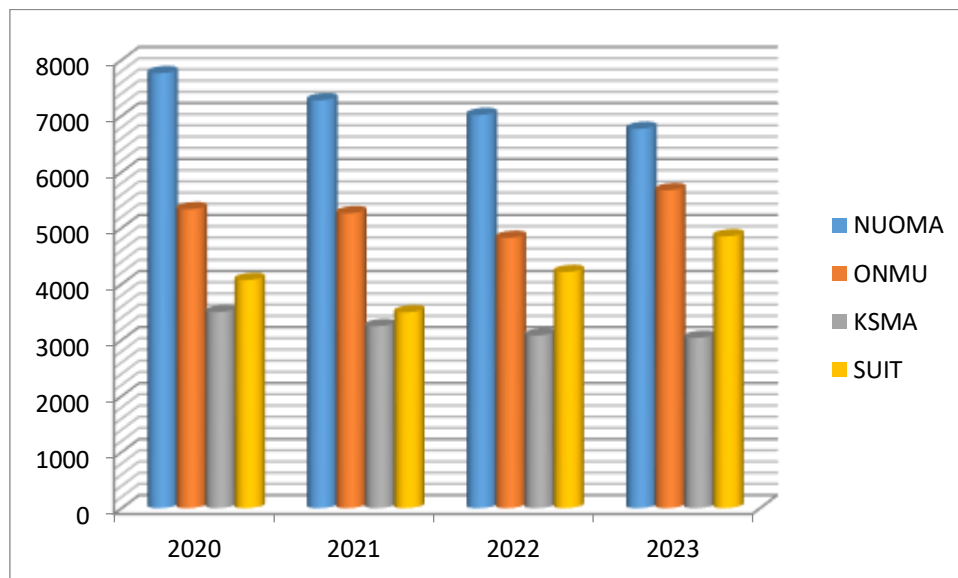
The most recent data from 2023 shows signs of recovery, with numbers rising to 20,334 students, representing a 6.3% increase from the 2022 low. While this uptick is encouraging, it's important to note that enrollment remains 7.3% below the 2020 baseline, indicating persistent challenges in student retention and recruitment.

At the same time, 47% of surveyed students indicated that the quality of education in their program had not changed, while 38% reported a slight decline. This suggests that the losses accumulated during the pandemic have only intensified with the onset of the war. Another significant aspect impacting the quality of higher education in Ukraine is full access to learning. A distinction should be made between the end of the 2021/2022 academic year and the beginning of the 2022/2023 academic year. While ensuring safe conditions for students and faculty was the main challenge in the spring, the situation worsened in the fall due to power outages, unstable internet access, and heating issues, which further deepened the crisis in organizing distance learning [30].

In the new academic semester, students, faculty, and staff in Ukrainian universities were forced to work as efficiently as possible within limited time periods when electricity and internet access were available in their homes or university facilities. Additionally, as during the pandemic, most Ukrainian higher education institutions only partially adapted their educational processes to the distance format. Changes in the formats of classes, assessment, scheduling, and so forth were not fully implemented. Despite faculty members' interest in teaching, students noted that most of them had not altered assessment criteria, adapted course content, or modified assignment types to suit the new learning conditions.

Between 2020 and 2023, several Ukrainian maritime and transport institutions, including saw varying trends in their enrollment numbers. The study aimed to analyze the enrollment campaigns at these universities and their structural subdivisions to understand student preferences, the impact of external factors such as economic and social changes, and the overall growth or decline in student interest in maritime and transport education (Fig. 2).

One of the most notable changes is the significant increase in the student body at the Kyiv institution, specifically in the State University of Infrastructure and Technologies (SUIT) in Kyiv. While in 2021 the number of students was 3,495, by 2023 this figure had risen to 4,851, representing an increase of approximately 38.8%. This growth can be explained by the mass relocation of students from occupied territories to the capital. Kyiv has become one of the main centers attracting students, as many universities in the capital offered the possibility of studying in safer conditions. Student mobility from dangerous regions significantly increased the student population in these institutions.



**Fig. 2. The dynamics of student enrollment in Ukrainian maritime higher education institutions (2020–2023)**

In contrast, Kherson State Maritime Academy (KSMA) has shown a significant decrease in enrollment. The number of students dropped from 3,499 in 2020 to 3,040 in 2023, reflecting a decline

of about 13.1%. This decrease is directly related to the prolonged occupation of Kherson, which has led to considerable difficulties in restoring the educational process. After the de-occupation of the city, the university faced numerous challenges, including infrastructure damage and staff shortages. Ongoing hostilities also contributed to the emigration of students, many of whom were unable to return to their studies.

The National University "Odesa Maritime Academy" (NUOMA) shows the most substantial decline in student enrollment over the period from 2020 to 2023 — from 7,763 to 6,769 students, a decrease of approximately 12.8%. This decline may be explained by the loss of its branch in Mariupol, which was captured by occupying forces. As some students were unable to evacuate, and a significant number who did relocate opted to continue their studies abroad, the total student population of the university decreased. The loss of this branch, which traditionally enrolled a significant number of students, had a substantial impact on the university's overall enrollment.

The Odesa National Maritime University (ONMU) demonstrates relative stability with a trend toward growth in recent years. This may reflect the institution's adaptation to new conditions, particularly through the transition to online learning formats, preservation of infrastructure, and the opportunity for students to continue their education amid wartime conditions.

The decline in student enrollment in these institutions reflects a combination of internal and external factors that hinder stable growth and development. Although there was some recovery in 2023, the overall situation remains challenging:

- The general trend shows a decline in enrollment from 2020 to 2022, likely due to economic and social factors, including the impact of the COVID-19 pandemic and the war. The instability of regions where maritime educational institutions are located, along with difficulties in restoring the educational process after lockdowns and occupation, has led to student outflows and a decrease in applicant numbers.

- In 2023, certain institutions, such as The Odesa National Maritime University (ONMU) and the the State University of Infrastructure and Technologies (SUIT), saw an increase in student numbers, which may indicate a degree of stabilization or enhanced recruitment efforts. Measures introduced by these institutions, such as tuition discounts, program enhancements, and recruitment campaigns, have contributed to this positive trend.

- However, the total number of students in 2023 remains below the 2020 level, indicating that the downward trend in higher education in Ukraine's maritime institutions persists. Despite some progress, challenges related to security, economic pressures, and competition with other educational institutions continue to affect the overall state of the sector.

Although a slight recovery was observed in 2023, the situation remains challenging. To stabilize and further develop maritime institutions, comprehensive measures are necessary, including improved security, reduced tuition costs, increased international support, and modernization of educational programs to enhance their competitiveness.

**Conclusions.** The higher education system of Ukraine is experiencing an unprecedented period of changes driven by a complex interweaving of geopolitical and epidemiological factors. Despite the complexity of the situation, the educational sector demonstrates significant adaptive potential and the ability to rapidly transform established paradigms.

Analysis of the current state of affairs indicates a substantial modification of approaches to organizing the educational process in higher education institutions. Despite the territorial dispersion of educational process participants, higher education institutions have managed to ensure the continuity of learning. This became possible due to flexibility and prompt response to new challenges.

It is worth emphasizing that this adaptation occurred against the backdrop of existing systemic transformations related to the implementation of European educational standards and modernization of the quality assurance system. These processes created additional foundations for implementing innovative approaches in teaching and management.

Undoubtedly, the extreme conditions faced by higher education threatened the stability of the educational landscape. However, the presence of an established regulatory framework, accumulated

experience of institutional changes, and high qualification of academic staff allowed Ukraine's higher education system to demonstrate flexibility and resilience to external influences.

Having passed this stress test, domestic higher education gained unique experience in reconfiguring educational practices. This potential for adaptation and transformation became key to maintaining educational quality and competitiveness of Ukrainian universities even under conditions of global upheaval. Further improvement of regulatory framework, digitalization of educational space, and strengthening of international cooperation will allow Ukraine's higher education system to fully unlock its modernization potential.

However, current demographic trends in Ukraine show concerning signs of outflow of intellectually and physically developed young population to other countries. This process, along with a complex of socio-economic problems, indicates a deep demographic crisis that threatens the national security of the state.

The situation in Ukraine's maritime education system causes particular concern. Analysis of reporting documentation from heads of specialized higher education institutions indicates a persistent trend of decreasing student contingent over recent years. This phenomenon becomes critical considering the strategic importance of the maritime sector for the country's economy and its position in the global maritime services market.

The roots of this problem should be sought in a complex of economic, social, and geopolitical factors that motivate Ukrainian youth to emigrate. Lack of prospects for decent employment, low income levels, and deteriorating quality of life in Ukraine become significant incentives for moving abroad. Moreover, the war initiated by Russia exacerbates these trends, complicating access to maritime education and career prospects in the field.

Negative demographic trends in Ukraine's maritime education system pose a threat to maintaining the competitiveness of domestic specialists in the international labor market. The decrease in the contingent of cadets and students in maritime specialties narrows the possibilities for sector staffing, threatening the future development of the national maritime sector.

Solving this problem requires comprehensive efforts at the state level. Key directions should include creating favorable socio-economic conditions for youth, ensuring a decent standard of living and career growth prospects. Simultaneously, it is necessary to implement targeted programs to popularize maritime professions and increase the prestige and attractiveness of sectoral education. Only a systematic approach can neutralize destructive demographic trends and preserve the human resource potential of Ukraine's maritime education.

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### Міграційно-еволюційні аналіз тенденцій розвитку морської освіти в умовах війни

Дослідження присвячене аналізу фундаментальних змін у системі вищої освіти України, що відбуваються під впливом безпрецедентних геополітичних подій та демографічних зрушень, з особливим фокусом на секторі морської освіти. У роботі досліджується період 2020-2023 років, що характеризується масштабними викликами, спричиненими російською військовою агресією та її наслідками для освітньої галузі. На основі аналізу інституційних звітів та статистичних даних виявлено суттєві зміни у динаміці студентського контингенту, перерозподілі освітніх потоків та трансформації освітніх практик. Результати дослідження демонструють, що попри значну адаптивність та успішне впровадження європейських освітніх стандартів, система вищої освіти України зіткнулася з серйозними викликами, пов'язаними з вимушеною міграцією молоді та демографічним спадом. Особливо гострою ця проблема постає у секторі морської освіти, де спостерігається стійка тенденція до зменшення кількості здобувачів освіти. У статті обґрунтовується необхідність системних державних заходів щодо розвитку морської освіти в Україні. Дослідження розкриває складну взаємодію між демографічними тенденціями, освітньою трансформацією та галузевим розвитком в умовах воєнного часу.

**Ключові слова:** вища освіта дорослих; освіта під час війни, морська освіта та навчання, конкурентоспроможність освіти, освітня міграція, MET.