HUMANITIES STUDIOS: Pedagogy, Psychology, Philosophy

Humanities Studios: Vol. 13, No. 3, 2025

Pedagogy, Psychology, Philosophy

Journal homepage: https://humstudios.com.ua/en

UDC 378.014.3:37.091.3:004.738.5

DOI: 10.31548/hspedagog/3.2025.23

Ways to overcome educational losses in higher technological education

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Abstract. The article analysed the challenges associated with overcoming educational losses in higher technological education in Ukraine during the COVID-19 pandemic and the ongoing war. In this research, particular attention was given to defining the concept of "educational losses", identifying their causes and consequences, and outlining strategic approaches to minimising their negative impact. The research aimed to identify effective strategies for addressing educational losses and enhancing the quality of higher technological education under crisis conditions. Key factors contributing to reduced learning efficiency are examined, including the transition to distance learning, deterioration in the psychological state of participants, a reduction in the student body, and the destruction of educational infrastructure. To address these challenges, the National University of Life and Environmental Sciences of Ukraine has implemented innovative measures such as expanding

Received 05.06.2025 Revised 26.08.2025 Accepted 23.09.2025

Suggested Citation:

Klikh, L., Zazymko, O., Nazarenko, V., & Rudyk, Ya. (2025). Ways to overcome educational losses in higher technological education. *Humanities Studios: Pedagogy, Psychology, Philosophy*, 13(3), 23-37. doi: 10.31548/hspedagog/3.2025.23.

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access to electronic courses via the MOODLE platform, launching a digital transformation programme, organising remedial courses for first-year students, and creating a supportive learning environment. Within the scope of the presented research, emphasis was placed on the advantages of a blended learning format that integrates theoretical and practical components more effectively. Significant attention was also given to psychological support for students and faculty, enhancing motivation and ensuring safety. The University has developed flexible learning algorithms that support parity between different educational formats, facilitating student integration into the learning process. The article concluded with recommendations for monitoring educational losses and improving curricula to maintain educational quality and adaptability in the face of modern challenges. The practical value of the study lies in offering a replicable model for educational institutions to respond effectively to crises, ensuring the continuity and resilience of higher education

Keywords: organisation of the educational process; electronic course platform; engineering education; educational policies

Introduction

The COVID pandemic, followed by the full-scale war, has posed an extraordinary challenge for higher education and caused problems in providing education and training for all sectors of Ukraine's labour market (Lokshina *et al.*, 2022). However, in this challenging period, Ukraine, more than ever, needs qualified technological personnel to prevent a food crisis and rebuild the country. Technological education has become a strategically important component in the training of qualified personnel, and the problem of educational losses in higher education institutions has become highly relevant, necessitating the study of their causes and the search for appropriate solutions.

The COVID-19 pandemic and global crises have profoundly impacted education systems, causing widespread learning losses and exacerbating inequalities (Nestulya & Shara, 2023). E. Hanushek & L. Woessmann (2020) explore the long-term economic implications of these learning losses, emphasising how reduced skill acquisition negatively affects labour market productivity and economic growth. They argue that these losses could reduce global GDP substantially over the coming decades, urging policymakers to prioritise remedial measures to mitigate the damage. Similarly, T. Kasradze & N. Zarnadze (2021) highlight the detrimental effect of pandemic-induced learning gaps on economic development. They note that the prolonged absence of effective learning environments, particularly in developing countries, has widened educational disparities, potentially limiting upward social mobility and intensifying socioeconomic inequality. Z. Blaskó *et al.* (2022) contribute to this discourse by mapping the educational inequalities in Europe that arose during the COVID-19 crisis. They identify specific demographic groups disproportionately affected by learning losses, such as students from low-income households, and advocate targeted interventions to bridge these gaps. Together, these studies underscore the critical intersection of education, economic development, and equity in addressing the challenges posed by global crises.

Beyond the pandemic, broader systemic disruptions, such as war and institutional transformations, have also reshaped the landscape of higher education. V. Antoniuk (2023) examines the war in Ukraine as a factor driving upheaval and transformation in the higher education sector, highlighting the resilience and adaptability of institutions under extreme conditions. The author underscores the importance of fostering

international collaboration and flexible policies to maintain academic continuity. Leadership values and trust emerge as crucial elements in managing uncertainty, as explored by B. Liu *et al*. (2022), who analyse how higher education leaders in the United States uphold core values and ethical principles during crises, emphasising the role of trust and transparent decision-making in sustaining institutional integrity. These studies collectively illustrate the multifaceted impacts of crises on education, ranging from immediate disruptions in learning to long-term structural transformations, while highlighting the role of leadership and innovation in fostering resilience.

O. Kulyk (2023) investigates how digital transformation is reshaping higher education. The author discusses the need for universities to adopt new technological models, highlighting flexibility, personalisation, and digital competence as crucial for future educational success. M. Neumann *et al*. (2023) explore the potential impacts of AI tools like ChatGPT on higher education. They stress the urgent need for open discussions about integrating AI into education while addressing opportunities and ethical challenges. R. Kelchen *et al*. (2021) examine the long-term financial repercussions of the COVID-19 pandemic on higher education institutions. They reveal that many colleges and universities, particularly smaller ones, face fiscal instability due to declining enrolments and changing funding structures. B. George & O. Wooden (2023) explore how artificial intelligence could strategically transform higher education management. They propose AI-driven solutions for improving decision-making, enhancing institutional resilience, and fostering more responsive educational environments. R. Sabates *et al*. (2021) use data from Complementary Basic Education programmes in Ghana to estimate learning losses resulting from COVID-19 school closures. They highlight that marginalised learners experienced significant setbacks, underscoring the need for remedial and transition programmes to mitigate long-term impacts. J. Casanova *et al*. (2023) examine the reasons behind first-year STEM student dropout rates, suggesting that factors beyond academic performance – such as motivation, social integration, and self-regulation skills – are critical. They advocate for more holistic student support systems to improve retention rates.

A significant danger of educational losses is that their consequences may become evident gradually, affecting the quality of life of individual citizens and the development of society as a whole. The hypothesis of the present study posited that the use of blended learning, adaptive educational technologies, and an individualised approach will help reduce educational losses among applicants for higher education in technological fields. Despite numerous studies on educational losses, the issue of overcoming these losses in higher technological education remains insufficiently explored. The available academic literature and the approaches it presents are mainly focused on general educational strategies. At the same time, the specifics of technological education require tailored methods to meet the needs of students in technical disciplines. This study proposed a comprehensive approach to minimising educational losses based on the use of adaptive learning technologies and individualised development trajectories, which distinguishes it from previous publications in this field. The study aimed to identify the main strategies for overcoming educational losses in higher technological education.

Materials and Methods

The methodological basis of the study relied on scientific methods such as analysis, synthesis, justification, generalisation, and systematisation of the results obtained. The statistical data presented in the research were compiled and analysed by the authors based on institutional documentation, including the official report Educational Activities of the University: Achievements and Results of 2024, and aggregated data from electronic reports submitted by the deaneries and directorates of the National University of Life

and Environmental Sciences (NULES) of Ukraine for reporting to the university's rectorate. These sources provided a reliable empirical basis for evaluating key indicators such as student enrolment dynamics, dropout rates, outcomes of intermediate certification, engagement in levelling and preparatory courses, and the level of digital course integration across technological faculties and educational institutes. The study of ways to overcome educational losses was carried out at the National University of Life and Environmental Sciences of Ukraine.

To conduct this comprehensive analysis, the authors employed a multifaceted methodological approach that extended beyond the compilation of institutional data. Document analysis was utilised to scrutinise official university reports, strategic plans for digitalisation, and regulatory documents concerning educational processes and safety protocols. This allowed for a thorough understanding of the implemented measures and their intended objectives. Comparative analysis was applied to examine the changes in key educational indicators (e.g. enrolment, dropout rates, certification results) over the period of study (2022-2024) and in comparison to pre-crisis data, enabling an assessment of the impact of implemented strategies. Furthermore, descriptive statistics were used to summarise and present the quantitative data in a clear and accessible manner, facilitating the identification of trends and patterns. Qualitative analysis of the implemented initiatives, such as the digital transformation programme and psychological support services, was conducted through the examination of programme descriptions and implementation reports. Finally, inductive reasoning was employed to derive overarching conclusions and recommendations based on the synthesis of the analysed data and observations regarding the effectiveness of the implemented strategies in mitigating educational losses within the specific context of the National University of Life and Environmental Sciences of Ukraine.

Results and Discussion

Defining and understanding educational losses in higher education

In addressing the issue of educational losses, it is necessary to begin by interpreting this concept and its main aspects both generally and in the specific context of the educational process within higher education institutions. In recent years, several related terms have emerged in both the media and academic literature, including "learning losses", "educational gaps", and "learning gaps" (Bychko & Tereshchenko, 2023). Educational losses are adverse consequences that arise within the higher education system and institutions as a result of natural disasters, global or regional pandemics, armed conflict, or other events that disrupt the organisation of the educational process, day-to-day learning, and the overall development of higher education. Such losses may include: interruption of the educational process due to natural disasters, pandemics, air raids, or other threats to the health or lives of participants in the educational process, thereby reducing its effectiveness; damage to or destruction of educational buildings, dormitories, or laboratory equipment; evacuation and relocation of staff and students; loss of access to educational resources due to server failures, power outages, or lack of communication; and a decline in the quality of practical learning resulting from the delivery of education in a remote format (Nazarenko, 2022).

The concept under study also encompasses the loss of opportunities to obtain a quality education. These losses may result from lack of access to quality education due to epidemics, natural disasters, social circumstances, inadequate infrastructure, financial constraints, and other such factors. That is, educational losses constitute a complex of issues that significantly affect the functioning of higher education institutions by reducing accessibility, causing interruptions in the educational process, and inflicting material damage on infrastructure. These effects may also include social consequences, psychological stress, and other forms of pressure (Bychko & Tereshchenko, 2023).

The State Service for Education Quality of Ukraine, with the support of the project Support for Government Reforms in Ukraine (SURGe), conducted a study on the quality of educational organisation during the 2022/2023 academic year to identify both educational losses and gains (State Service of Education Quality of Ukraine, 2023). According to the study, losses in the educational process may be recognised as changes in the mode of instruction, including the transition from fulltime to distance or blended learning, as well as unstable conditions for organising the educational process.

Thus, the distance and blended learning formats – first introduced in response to the COVID19 pandemic and still in use at some institutions – significantly limit the development of practical skills. This is particularly problematic in technological programmes, where the practical component is markedly more important than in the humanities. Moreover, these formats do not contribute to improved academic performance or increased motivation to study within the university community, as evidenced by the data in Table 1, which details the number of students expelled from technological programmes at NULES of Ukraine between 2022 and 2024. In 2024 alone, 1,173 students were expelled from technological programmes for various reasons, a figure that significantly exceeds prewar levels.

Table 1. *Number of expelled students in technological specialities at NULES of Ukraine, 2022-2024*

Faculties/Institutes	2022	2023	2024
Plant Protection, Biotechnology and Ecology	44	64	96
Information Technologies	72	124	7
Education and Research Institute of Energetics, Automation and Energy Efficiency	54	90	105
Food Technology and Quality Control of Agricultural Products	25	44	109
Design and Engineering	31	43	104
Land Management	35	37	51
Agrobiological	57	136	168
Livestock Raising and Water Bioresources	56	87	110
Education and Research Institute of Forestry and Landscape-Park Management	98	153	111
Mechanical and Technological	40	88	124
Veterinary Medicine	76	145	188

Source: *compiled by the authors based on the report Educational Activities of the University: Achievements and Results of 2024*

At the same time, under conditions of instability, many students prefer to study at European universities, which can lead to a decrease in domestic student numbers and negatively affect the financial stability and overall efficiency of the university. A significant challenge has been ensuring the safety of students, academic staff, and other university personnel, particularly due to the limited number of shelters, the need to develop and implement security measures, install warning and evacuation systems, and provide training on emergency response procedures. Limited resources, power supply interruptions, and poor internet connectivity continue to create barriers to distance learning and hinder access to essential educational materials and resources.

Several key factors have been identified as contributing to increased educational losses, including: restricted access to the educational environment; the psychological state of participants in the educational process; a reduction in the number of applicants to higher education; safety concerns for students, researchers, and academic staff; technological challenges (Fig. 1).

Figure 1. *Key challenges faced by the university under martial law*

Source: *compiled by the authors based on the report of the NULES Rector, presented at the meeting of the university workforce in December 2024*

At the same time, traditional challenges in higher technological education remain relevant. These include issues of accessibility and inclusiveness; flexibility of the educational process for specific categories of low-income students; the implementation of individualised learning trajectories; and the introduction of dual education or its elements. Additional challenges complicating the implementation of educational activities at NULES of Ukraine include: demographic shifts due to the outflow of students and academic staff abroad; an oversupply of educational services in Ukraine, coupled with the increasing availability of higher education abroad; a significant decline in demand among today's youth for complex professions in engineering and natural sciences; decreasing motivation among teaching staff to actively enhance the quality of educational programmes.

Key strategies for overcoming educational losses in technological higher education

Having analysed the experience gained in improving the educational process over the past few years at NULES of Ukraine, it is possible to identify key areas for addressing educational losses in higher technological education. A high level of digitalisation and the availability of a range of modern digital services for students and academic staff play a crucial role in enhancing the quality of the educational process. As part of the university's digital transformation programme, significant progress has been made in a short period across several areas, including the modernisation of the educational process, resource management, and enhancement of information security. Notable achievements include the following: development of a system for publishing class schedules; introduction of a student portal providing access to class timetables, academic performance, individual curricula, university surveys, and the option to select courses within the individual study plan; implementation of a cybersecurity policy aimed at protecting data belonging to the university, students, staff, and other stakeholders in the educational process; improvement of the infrastructure's reliability and energy independence through backup power systems and an emergency data recovery solution;

initiation of the automation of document management through the creation of a unified digital environment for managing human resources, finances, and material assets; connection to the Eduroam global network, enabling all participants in the educational process to access the Internet via a secure, standardised platform. Thanks to these initiatives, the university has made substantial progress in implementing modern digital technologies, thereby improving both educational quality and administrative efficiency. Another important measure to reduce educational losses has been the assessment of firstyear bachelor's students' baseline knowledge, followed by the provision of free bridging courses in science, mathematics, and the humanities. These courses have significantly helped close knowledge gaps among first-year students (Table 2).

Table 2. *Participation of first-year students in free bridging courses in science, mathematics, and the humanities, 2022-2025*

Course	2022-2023 AY, students	2023-2024 AY, students	2024-2025 AY, students
Mathematics	784	905	1,197
Chemistry	172	168	176
Physics	203	231	239
Biology	67	84	98
Foreign language	131	145	105
Total	1,357	1,533	1,815

Source: *compiled by the authors based on the report Educational Activities of the University: Achievements and Results of 2024*

First-year students enrolled in technological programmes at the following educational institutes and faculties participated in the free bridging courses in science, mathematics, and the humanities: the Education and Research Institutes of Energetics, Automation and Energy Efficiency, and Forestry and Landscape-Park Management; and the Faculties of Livestock Raising and Water Bioresources; Mechanical and Technological; Design and Engineering; Plant Protection, Biotechnology and Ecology; Land Management; Information Technologies; Food Technology and Quality Control of Agricultural Products; Veterinary Medicine; Agrobiological, and others.

Mid-semester interim certification of higher education applicants plays an important role in enhancing motivation for academic engagement. This procedure was introduced at the university more than 15 years ago and has been shown to encourage students to improve their level of knowledge. The results of certification for students enrolled in technological educational programmes are presented in Table 3. The use of an adaptive blended learning format – integrating digital services, the Electronic Educational Environment (EEE), and a system for diagnosing initial knowledge – has made it possible to reduce the certification failure rate among higher education applicants to an average of 6.5% (Table 3). This outcome supports the effectiveness of the university's strategy for addressing educational losses under martial law conditions.

Table 3. *Summary of certification results for applicants to technological educational programmes in the first semester of the 2024-2025 academic year*

Faculties/Institutes	Number of students	Passed interim certification	Failed interim certification
Education and research institute of Energetics, Automation and Energy Efficiency	604	558	46
Education and Research Institute of Forestry and Landscape-Park Management	560	426	134

Table 3. *Continued*

Faculties/Institutes	Number of students	Passed interim certification	Failed interim certification
Agrobiological	1,204	1,113	91
Veterinary Medicine	1,338	1,302	36
Plant Protection, Biotechnology and Ecology	744	723	21
Land Management	404	383	21
Information Technologies	1,036	863	173
Design and Engineering	495	474	21
Mechanical and Technological	678	619	59
Livestock Raising and Water Bioresources	684	672	12
Food Technology and Quality Control of Agricultural Products	357	338	19

Source: *compiled by the authors based on the report Educational Activities of the University: Achievements and Results of 2024*

The following chart illustrates the proportion of students who passed the interim certification, highlighting distinctly divergent outcomes across faculties (Fig. 2). The highest success rates are observed in the veterinary medicine and agrobiology programmes. In contrast, a comparatively larger number of students failed to pass certification in certain areas of engineering and information technology. This disparity can be attributed to the practice-oriented nature of laboratory-based learning. Additionally, engineering and IT programmes demand a higher level of proficiency in computational tasks – skills that students may not be immediately prepared to demonstrate in a blended learning environment. Nevertheless, in most educational programmes, the number of students who passed the certification substantially exceeded those who did not.

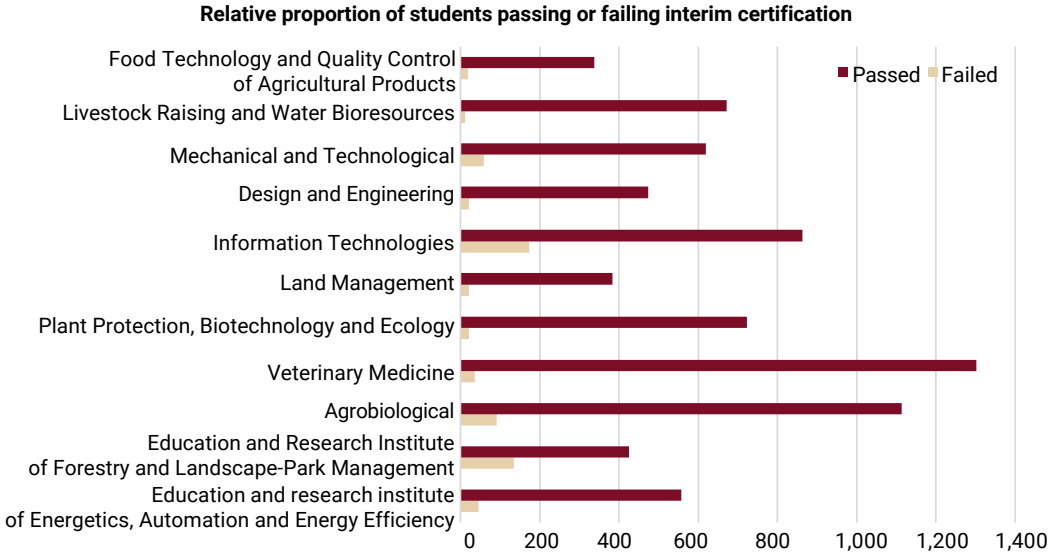

Figure 2. *Relative proportion of students passing or failing interim certification*

Source: *compiled by the authors based on data from electronic reports of university faculties and institutes for submission to the rectorate*

A significant contribution to mitigating educational losses is made by the university's preparatory courses. These offer school leavers planning to enrol at NULES of Ukraine the opportunity to strengthen their knowledge in science, mathematics, and the humanities. The quantitative data on participation in these courses are presented in Table 4.

Table 4. *Participation trends in ongoing consulting and preparatory courses*

Academic year	Total number of active students
2019-2020	257
2020-2021	233
2021-2022	285
2022-2023	211
2023-2024	252

Source: *compiled by the authors based on data from electronic reports of university faculties and institutes for submission to the rectorate*

An important component was also the support of the psychological well-being of participants in the educational process. This included the expansion of services offered by psychological support centres, the provision of varied opportunities for organised recreation, such as sports competitions, cultural events, and seminars for non-academic staff aimed at enhancing emotional and psychological resilience. Over the past three and a half years, the organisation of the educational process at the University has undergone significant changes in response to the challenges faced by the higher education system – including the military aggression by the Russian Federation, quarantine restrictions, and other external threats.

The University extensively utilises the potential of a blended learning format, which yields fundamentally improved educational outcomes for students compared to fully online learning. At NULES of Ukraine, the blended format involves a flexible combination of remote lectures, consultations, selected practical sessions, and in-person contact between lecturers and students in laboratory work, practical and seminar classes, placements, examination sessions, and thesis defences – depending on the programme and faculty. NULES of Ukraine offers two distinct scheduling algorithms for the delivery of full-time education during each semester, according to the European Student Identifier (ESI) (Fig. 3). For students pursuing higher education at all academic levels in technological disciplines – including engineering, veterinary medicine, and agrobiology – frequent rotation between in-person and remote learning formats throughout the semester is advisable. This is due to the significant number of laboratory and hands-on sessions embedded in the curricula, for which the University provides a strong material and technical infrastructure, including state-of-theart equipment and facilities. For students in economics, management, humanities, and teacher training programmes, a scheduling model involving a single mid-semester rotation between in-person and online formats is typically used. This algorithm was developed and successfully implemented by the University. Both scheduling models ensure parity between full-time and remote learning formats, helping to narrow the gap between theoretical knowledge and practical application. Their use has led to increased student attendance, improved integration into university life, and the development of a supportive socio-psychological environment within academic groups.

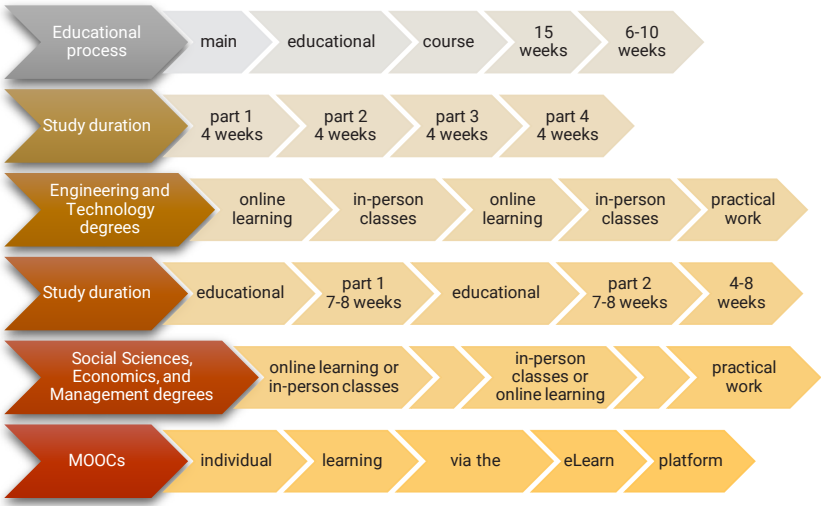

Figure 3. *Algorithms for organising student learning at NULES of Ukraine*
Source: *compiled by the authors*

The University pays special attention to the training of first-year bachelor's and first-year master's students in full-time study. During the organisation of the educational process for these categories of students, faculties and ESI are recommended to conduct classes in person throughout the academic year to prevent educational losses among individuals who have only recently begun their studies at the University. The primary reason for switching to distance learning is the deterioration of the security situation or adverse weather conditions during the cold season.

An important point was the expansion of access to the educational environment for higher education students, implemented through the development and use of modern e-learning courses, which are accessible from any location and supported by the resources of the National Centre for Education (NCE). To this end, since 2003, the University has used the MOODLE platform (Modular Object-Oriented Dynamic Learning Environment) as the central digital learning management system. MOODLE enables the creation, delivery, and management of structured online academic content, including interactive modules, video lectures, reading materials, quizzes, and assignments. The platform ensures asynchronous access to educational materials, allowing students to study independently and revisit content as necessary.

Each EEE developed within MOODLE is designed according to instructional design principles and curricular requirements, with content regularly reviewed and updated by course instructors and faculty coordinators. These courses include theoretical materials – such as digital lecture notes, scholarly readings, and explanatory videos – and practical components such as case studies, simulations, problem-solving tasks, and laboratory work instructions. Knowledge control tools integrated into the system include automated quizzes, formative and summative assessments, peerreviewed tasks, and plagiarism detection functionalities. Additionally, MOODLE's analytics tools allow instructors and administrators to monitor student progress, participation, and performance in real time, supporting data-driven decisions for instructional improvement.

The University's methodological approach emphasises the integration of blended learning, where EEE materials complement in-person sessions, supporting a more flexible and resilient

educational model. As shown in Table 5, the number of developed and implemented electronic courses increases with each academic year, reflecting the growing demand for digital access and the institutional commitment to quality assurance in remote and hybrid education formats.

Table 5. *Provision of electronic learning courses for academic disciplines at technological faculties and educational institutes*

Faculties/Institutes	Total number of courses	Courses with digital versions	Provision, %
Plant Protection, Biotechnology and Ecology	168	168	100
Information Technologies	111	111	100
Education and research institute of Energetics, Automation and Energy Efficiency	123	123	100
Food Technology and Quality Control of Agricultural Products	109	109	100
Design and Engineering	77	77	100
Land Management	153	144	94
Agrobiological	157	139	89
Livestock Raising and Water Bioresources	186	144	77
Education and Research Institute of Forestry and Landscape-Park Management	228	172	75
Mechanical and Technological	89	61	69
Veterinary Medicine	115	76	66

Source: *compiled by the authors based on the report Educational Activities of the University: Achievements and Results of 2024*

The findings of this study, which demonstrate the effectiveness of adaptive learning technologies, digital course integration via MOODLE, and individualised educational trajectories in overcoming educational losses in higher technological education, are broadly consistent with – and in some respects expand upon – the findings of recent international research.

For instance, M. Akour & M. Alenezi (2022) argue that digital transformation is crucial for the future of higher education, particularly in ensuring continuous access and engagement during crises. Their emphasis on flexible, student-centred learning aligns with the initiatives implemented at NULES of Ukraine, notably the introduction of a blended format that integrates digital and in-person elements. However, while M. Akour & M. Alenezi (2022) focus primarily on the broader pedagogical potential of digital platforms, the present study offers a more practical implementation model. Similarly, the research of P. Lara-Navarra *et al.* (2024) stresses the need for educational systems to innovate in the face of rapid and unpredictable change. Their advocacy for dynamic, creative institutional adaptation mirrors the NULES strategy of deploying multiple educational algorithms, adaptive scheduling, and modular learning. Both studies highlight the necessity of flexibility, yet the Ukrainian case uniquely demonstrates this through wartime adaptations such as security-based scheduling and energy-independent infrastructure. In contrast, studies such as that by S. Stein (2019) adopt a more critical perspective on global higher education, questioning whether current frameworks can adequately respond to profound uncertainties. While S. Stein (2019) recommends a shift towards ethical and relational responses to global complexity, the current study remains within a pragmatic domain. Nevertheless, both share an underlying recognition of uncertainty and the call for systemic transformation.

In relation to the development of technological competencies and employment readiness, V. Goulart *et al.* (2021) underscore the importance of balancing technical and soft skills within

digital education. A key contrast arises in comparison with the empirical analysis conducted by P. Engzell *et al.* (2021), who document substantial learning losses during school closures, particularly among vulnerable groups. While their study indicates a general academic decline, the present research demonstrates that institutional measures such as early diagnostics, structured certification, and hybrid teaching can partially mitigate this trend. Moreover, despite wartime conditions, the 6.5% average failure rate among technological students at NULES suggests that educational recovery is achievable through targeted interventions. This position is supported by the findings of H. Patrinos *et al.* (2023), who stress the need for data-driven educational strategies in response to Europe-wide learning losses. The comprehensive use of analytics within MOODLE at NULES, coupled with the centralised diagnostic testing of first-year students, reflects precisely this kind of informed, adaptive educational planning. While H. Patrinos *et al.* (2023) focus on policy recommendations, the present study provides a functional institutional case study that validates those recommendations.

In the context of dropout prevention, P. Bahr *et al.* (2023) emphasise the importance of addressing non-academic factors in retaining STEM students. The current study's integration of psychological support services, campus life activities, and individualised student trajectories directly addresses these concerns, offering a complementary perspective to the institutional recommendations of P. Bahr *et al.* (2023). Finally, the analysis by L. Moscoviz & D. Evans (2022) underscores a persisting global issue: learning loss and student attrition remain acute even two years after school closures. While their review highlights the scale of the crisis, the present study offers an optimistic counterpoint by demonstrating measurable improvements through structured, blended learning strategies. Taken together, this comparative analysis shows that although the challenges of educational losses are widely recognised in global research, practical solutions require context-specific implementation. The Ukrainian experience, particularly at NULES, contributes to the literature a model of resilience grounded in technological innovation, individualised education, and organisational adaptability under crisis conditions. It supports the broader scholarly consensus that blended learning formats and institutional agility are both desirable and necessary in safeguarding educational quality during systemic disruptions.

Conclusions

The main approaches to addressing educational losses in higher technological education are identified in the research process. The mechanism presented for implementing the university's educational activities enables it to mitigate educational losses effectively, ensure the continuous provision of high-quality educational services, and respond flexibly to current challenges. The statistical analysis results presented in the study demonstrate that the most vulnerable to educational losses are students enrolled in programmes with a significant practical component, particularly future veterinarians, agronomists, and agricultural engineers. The high number of student withdrawals (over 1,100 in 2024) indicates the systemic nature of the problem and underscores the need for structural changes in the organisation of the educational process. The study utilises data derived from a single university, highlighting the need for further inter-university comparative analysis to identify universal mechanisms for addressing educational losses in technological education.

To overcome these losses, it is necessary to ensure continuous annual monitoring of programme learning outcomes among higher education students in accordance with the Higher Education Standards of Ukraine for each speciality, using modern computer equipment, software, and diagnostic tools. It is also essential to undertake adaptive, flexible planning of the educational process, incorporating a flexible timetable, redistribution of study time across academic disciplines and topics within the developed curricula,

and adjusting educational content to reflect identified learning gaps. Further efforts should be directed towards developing a methodological system to support the individual educational trajectory of each student, including individualised instruction and independent study in accordance with the curriculum or learner needs; consultations to eliminate knowledge gaps in specific subjects; and tailored tasks of varying levels of complexity. Additionally, the support system for academic and teaching staff should be enhanced, particularly regarding opportunities for continuing professional development, internships, and industry placements. The findings of this study highlight the need for future research focused on developing predictive models for educational loss using machine learning, and on evaluating the impact of blended learning formats on the development of professional competencies among students in technical disciplines compared to traditional educational models.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Шляхи подолання освітніх втрат у вищій технологічній освіті

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Анотація. У статті проаналізовано виклики, пов'язані з подоланням освітніх втрат у вищій технологічній освіті України під час пандемії COVID-19 та війни, що триває. Особливу увагу приділено визначенню поняття «освітні втрати», виявленню їх причин та наслідків, а також окресленню стратегічних підходів до мінімізації їх негативного впливу. Метою роботи було визначення ефективних стратегій мінімізації освітніх втрат та підвищення якості вищої технологічної освіти у кризових умовах. Були розглянуті ключові фактори, що сприяли зниженню ефективності навчання, серед яких перехід на дистанційну форму навчання, погіршення психологічного стану учасників, скорочення студентського контингенту, руйнування освітньої інфраструктури. Для вирішення цих проблем Національний університет біоресурсів і природокористування України впровадив інноваційні заходи, такі як розширення доступу до електронних курсів через платформу MOODLE, запуск програми цифрової трансформації, організація корекційних курсів для студентів-першокурсників та створення сприятливого навчального середовища. В рамках представленого дослідження було зроблено акцент на перевагах формату змішаного навчання, який ефективно інтегрує теоретичні та практичні компоненти. Значну увагу також було приділено психологічній підтримці студентів та викладачів, підвищенню їхньої мотивації та забезпеченню безпеки. Університет розробив гнучкі алгоритми навчання, які підтримують паритет між різними освітніми форматами, полегшуючи інтеграцію студентів у навчальний процес. Стаття завершується рекомендаціями щодо моніторингу освітніх втрат та вдосконалення навчальних програм для підтримки якості освіти та адаптивності в умовах сучасних викликів. Практична цінність роботи полягає в тому, що вона пропонує тиражовану модель для навчальних закладів для ефективного реагування на кризові ситуації, забезпечення безперервності та стійкості вищої освіти

Ключові слова: організація освітнього процесу; платформа електронних курсів; інженерна освіта; освітня політика