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## Raising awareness of environmental safety among higher education students

**Abstract.** The purpose of this study was to analyse curricula and courses containing a patriotic component aimed at raising students' awareness of environmental safety. The research methodology included a theoretical analysis of curricula, a content analysis of potential risks at hazardous facilities, and the development of recommendations for improving curriculum content. The curricula provided students with knowledge of environmental safety, as well as civic and patriotic awareness, combining theoretical knowledge with practical skills in responding to emergencies. At the same time, insufficient integration of interdisciplinary and practical modules was identified, which limited the development of critical thinking, active citizenship, and the application of knowledge in real professional and social contexts. Content analysis showed that educational materials and regulatory documents systematise potential threats and classify them by type and level of danger, which enabled students to form an initial understanding of risks and to assess their impact on the educational process. Recommendations for improving academic disciplines include updating programme content through the inclusion of patriotic and civic components, strengthening interdisciplinary links, developing new modules and specialised courses, integrating modern digital technologies and artificial intelligence for the analysis of environmental data, improving criteria for assessing civic competencies, and expanding partnerships between educational institutions and public organisations. The implementation of these changes is intended to foster in students a holistic understanding of the role of a specialist in society, to increase motivation to preserve national identity, and to develop environmental responsibility, critical thinking, and civic engagement as components of professional training. The practical significance of this work lies in the fact that its results can be used by teachers of environmental safety and civil protection disciplines to design curricula and practical classes on risk modelling at hazardous facilities

**Keywords:** students; teachers; protective measures; civil protection; emergencies

### INTRODUCTION

The relevance of this study is determined by the need to increase environmental awareness among higher education students in the context of intensifying global environmental problems, particularly climate change, environmental pollution, and the depletion of natural resources. Despite

the growing number of educational programmes, the formation of environmental awareness remains insufficiently integrated into the educational process, which creates gaps in the preparation of future specialists for responsible professional activity. It is within the student community

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that the potential for environmental culture, values, and an active civic position necessary for the implementation of the principles of sustainable development is formed. The research problem is to identify effective pedagogical approaches that ensure not only the acquisition of environmental knowledge, but also the development of conscious responsibility for nature conservation.

Researchers have examined various approaches, methods, and educational models that contribute to the development of students' environmental awareness in the process of implementing the principles of sustainable development. For example, the study by M. Ali *et al.* (2023) demonstrated that educational programmes aimed at developing students' environmental awareness increase their understanding of environmental problems through a combination of theoretical instruction and practical tasks. The authors showed that an interdisciplinary approach contributes to awareness of the relationships between natural processes and human activities. Similar results were obtained in the study by J. Debrah *et al.* (2021), which emphasised that formal education plays a positive role in disseminating knowledge about solid waste management in developing countries. In particular, the researchers highlighted that increasing students' environmental awareness through training courses and information campaigns led to changes in behavioural patterns and contributed to a transition towards a more responsible attitude to resource consumption. The problem of integrating environmental education into higher education is examined in the work of T. Ferguson & C. Roofe (2020), who focused on the challenges and opportunities associated with implementing the fourth Sustainable Development Goal related to ensuring quality education within the university system. In addition, involving students in environmental projects and volunteer initiatives not only increases awareness, but also develops civic engagement and responsibility.

The article by T. Kuts & O. Makarchuk (2023) found that students of the National University of Life and Environmental Sciences of Ukraine demonstrate an average level of environmental awareness, while showing a high willingness to participate in environmental protection activities. It was also determined that the effectiveness of environmental education increases under conditions of active use of interactive methods, environmental training, and project-based work. The study by E. Manolis & E. Manoli (2021) demonstrated that the implementation of environmental projects within university programmes ensures the formation of students' understanding of global environmental problems and the goals of sustainable development. Their results showed that such projects stimulate the development of critical thinking and collective responsibility, forming a sense of personal involvement in solving environmental challenges among students. In a broader analytical dimension, B. Mahanta & B. Sarkar (2023) conducted a literature review on the integration of education, research, campus management, and community initiatives to ensure sustainability in higher

education. The researchers concluded that the integration of these components ensures more effective implementation of environmental principles in the educational process, as students are involved in real-world environmental practices within the university context.

The issue of environmental education during periods of socio-political instability was addressed in the study by T. Nahirniak (2022), which noted that even under conditions of martial law in Ukraine, the formation of environmental culture remains a necessary component of national security. Increasing the environmental awareness of citizens, particularly students, is viewed as a means of strengthening societal resilience. The social dimension of environmental education was analysed by G. Santos *et al.* (2020), who found that the corporate social responsibility of higher education institutions has a positive impact on the quality of educational services and on levels of student satisfaction. The study by C. Toquero (2020) focused on new educational opportunities that emerged during the COVID-19 pandemic. The author noted that distance learning formats provide additional resources for the development of environmental awareness through the use of digital platforms that offer access to environmental information, interactive courses, and international discussions. The international dimension of disseminating the ideas of sustainable development in higher education was highlighted by V. Zinchenko *et al.* (2021), who analysed the potential of universities in implementing environmental strategies. They concluded that Ukraine is gradually integrating European approaches to the development of environmental education; however, this process requires systematic updating of programmes and an increased level of interdisciplinarity.

The above studies revealed gaps in the alignment of curricula and courses with a patriotic component with state and European standards, as well as insufficient integration of practical safety aspects related to work with high-risk facilities. In addition, a lack of systematised data on harmful and hazardous production factors within the educational process was identified, indicating the need for further modelling and risk assessment. The purpose of this study was to examine the content of curricula and disciplines that include a patriotic component, with an emphasis on shaping students' understanding and awareness of environmental risks and hazards. The objectives of the study were: (1) to conduct a comparative analysis of curricula and courses with a patriotic component; (2) to assess potential environmental risks within the discipline "Environmental Safety and Civil Protection"; (3) to model scenarios of harmful and hazardous production factors; and (4) to formulate recommendations and proposals for improving these disciplines.

## MATERIALS AND METHODS

The study was conducted in May 2025 at the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". This higher education institution was

selected because it is a leading university in Ukraine with a well-developed infrastructure for training specialists in the field of occupational health and environmental safety. The study involved a comparative analysis of current curricula and courses that include a patriotic component. For this purpose, the following educational programmes were examined: the National University of Civil Protection of Ukraine – Educational and Professional Programme “Ecological Safety” (2024), Lviv State University of Life Safety – Educational and Professional Programme “Occupational Safety” (2024), and Igor Sikorsky Kyiv Polytechnic Institute – Educational and Professional Programme “Occupational Health and Safety” (2025).

These programmes were selected because they contain, or allow for the integration of, a patriotic component and civic education, which corresponds to the objectives of the study concerning the development of students’ civic competence. The analysis of curriculum content was carried out on the basis of the state standards of Ukraine, in particular the Order of the Ministry of Education and Science of Ukraine No. 96 “On Approval of Higher Education Standards” (2024), the Order of the Ministry of Education and Science of Ukraine No. 1076 “On Approval of the Higher Education Standard for Specialty 101 “Ecology” for the First (Bachelor’s) Level of Higher Education” (2018), and the DSTU ISO 45001:2019 (2019). The evaluation of curricula in relation to European trends was conducted using documents of the Organisation for Economic Co-operation and Development (2025) and the Council of Europe (2018). In addition, current trends in environmental threats were described on the basis of documents from the International Energy Agency (2025).

A comparative analysis of the curricula was carried out according to the following parameters: content blocks of patriotic and civic education, integration of environmental and civil security, and compliance with state and international standards. A content analysis of potential risks associated with nuclear power plants and other high-risk facilities (chemical plants, oil and gas refineries, fuel and ammunition depots, and hydraulic structures) under wartime conditions was conducted within the discipline “Environmental Safety and Civil Protection”. This content analysis was performed by systematising threats at nuclear, chemical, oil and gas, and other critically important facilities, and by assessing the probability of their occurrence and their potential impact on the educational process using data from state regulatory documents, educational materials, and international publications. The sources of information included course teaching materials, state regulatory documents on civil protection, and international publications on the safety of nuclear and critically important facilities, in particular those of the International Atomic Energy Agency (2025) and the United Nations Office for Disaster Risk Reduction (2021). The method involved systematising potential threats and assessing their probability and impact on the educational process. Based on the research conducted,

recommendations were developed to improve the content of the disciplines.

## RESULTS

### Comparative analysis of curricula and courses with a patriotic component

Curricula in higher education institutions ensure that students are aware of environmental threats and promote a holistic understanding of the relationship between human activity and the state of nature. Among the main environmental threats that students should recognise are climate change and global warming, air, water, and soil pollution, deforestation, overuse of natural resources, waste accumulation, and biodiversity loss (Vilcapoma-Malpartida *et al.*, 2023). These phenomena affect human health, economic stability, and quality of life; therefore, the educational process is aimed at fostering a responsible attitude towards the environment and an understanding of the consequences of individual actions. Curricula include disciplines related to ecology, sustainable development, climate change, and energy efficiency, which enable students to acquire knowledge about the causes and consequences of environmental crises and ways of overcoming them (Shri & Tiwari, 2021). The use of an interdisciplinary approach makes it possible to integrate environmental, social, economic, and technological aspects, demonstrating how professional activity in any field influences the state of nature.

Within the framework of the comparative analysis, it was found that the patriotic component is integrated into curricula through disciplines that develop the ability to act under conditions of risk, knowledge of the regulatory and legal foundations of civil protection, and skills for responding to emergency situations. The Educational and Professional Programme “Ecological Safety” (2024) at the National University of Civil Protection of Ukraine (Faculty of Technogenic and Environmental Safety, Department of Occupational Safety and Technogenic and Environmental Safety) provides training for bachelors in ecology with a specialisation in environmental safety. The programme comprises 240 European Credit Transfer and Accumulation System (ECTS) credits and is accredited by the Ministry of Education and Science of Ukraine until 2023. It is delivered in Ukrainian and includes problem-oriented and student-centred learning through lectures, seminars, practical and laboratory classes, distance-learning platforms, and the case method. The programme develops general (K01-K13), special (K14-K26), and complex professional competencies (SK27-SK31), which enable students to solve complex tasks in the field of ecology, assess environmental conditions, predict the consequences of emergencies, implement environmental monitoring, manage environmental projects, and conduct public education activities. Graduates may be employed as environmental safety specialists, state supervision inspectors, or consultants in environmental management, or may continue their studies at the master’s level to obtain additional qualifications.

In contrast, the master's Educational and Professional Programme "Occupational Safety" (2024), implemented at Lviv State University of Life Safety, is aimed at training highly qualified specialists in the field of civil and industrial safety, labour protection, and risk management. The programme combines theoretical and practical training and includes the study of concepts, categories, principles, and strategies for the development of civil security, as well as methods of assessment, modelling, and risk management, and tools for protecting the population, territories, and facilities in emergency situations. It integrates lectures, practical classes, seminars, laboratory work, course projects, and practical training based at the State Emergency Service of Ukraine, governmental bodies, and enterprises, which enables students to apply their knowledge in real conditions. The programme develops competencies in research and innovation activities, including information analysis, effective decision-making, team management, planning preventive and emergency measures, the use of modern information technologies, and international cooperation in the field of civil security. Training in the assessment and minimisation of industrial and technogenic risks contributes to ensuring occupational safety and preventing accidents and occupational diseases, thereby increasing students' awareness of environmental and technogenic threats. Graduate employment opportunities include positions as industrial safety experts, occupational safety engineers, department heads, researchers, and teachers. Thus, the programme integrates modern scientific knowledge and practical skills aimed at developing a comprehensive understanding of civil safety, occupational safety, and risk management in the context of industrial and environmental threats.

The Educational and Professional Programme "Occupational Safety" at the second (Master's) level of higher education is focused on training specialists capable of managing occupational risks and ensuring the safety and

health of workers through a risk-based approach, the principles of sustainable development, and compliance with national and international legislation. The programme provides instruction in practical methods and tools for monitoring working conditions, including the use of sound level meters, vibrometers, lux meters, gas analysers, dust meters, thermal imagers, dosimeters, and multifunctional meteorological instruments to assess physical, chemical, and radiation factors in the production environment. Considerable attention is devoted to auditing and monitoring working conditions in accordance with the requirements of the DSTU ISO 45001:2019 (2019), the application of HAZOP, FMEA, and risk matrices, as well as the use of software tools for processing measurement results and predicting occupational risks. The programme ensures the development of competencies in designing engineering, technical, and organisational safety measures, preparing feasibility studies, implementing occupational health and safety management systems, conducting briefings and staff training, and making managerial decisions in an interdisciplinary and international professional environment. All three programmes, despite differences in level of training and structure, integrate environmental, technogenic, and civic components harmonised with European approaches to safety and civic education. Their distinctive feature lies in the combination of theoretical instruction with a substantial number of practical classes, simulations, and team-based exercises, which enables the formation of not only professional but also socially responsible competencies in future specialists. Curricula in higher education institutions must comply with the state standards of Ukraine and European trends in civic education, as such compliance ensures the coherence of educational objectives, the development of professional and civic competencies, and the improvement of the quality of training of future specialists (Table 1).

**Table 1.** Comparative analysis of curricula according to the criteria of compliance with state standards of Ukraine and European trends in civic education

| Name of educational programme                          | Compliance with state standards of Ukraine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Compliance with European trends in civic education                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational-Professional Programme "Ecological Safety" | <p>The programme is developed in accordance with the Order of the Ministry of Education and Science of Ukraine No. 96 and the Order of the Ministry of Education and Science of Ukraine No. 1076. It ensures the formation of competencies in environmental safety, assessment of anthropogenic risks, environmental monitoring, and the management of natural systems.</p> <p>The curriculum includes the following disciplines: Ukrainian language (for professional orientation), higher mathematics, physics, a foreign language, fundamentals of information technologies, environmental safety, general ecology, meteorology and climatology, and environmental monitoring as mandatory components of the programme.</p> | <p>The programme is consistent with the approaches of the Organisation for Economic Co-operation and Development. It develops civic competencies through the topics "Environmental Responsibility of the Community", "European Environmental Policy", and "Public Participation in Environmental Decision-Making". It includes field practice, case analysis (for example, "Protection of Natura 2000"), and group work on environmental projects, which foster active citizenship and responsibility for the environment.</p> |

Table 1. Continued

| Name of educational programme                                         | Compliance with state standards of Ukraine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Compliance with European trends in civic education                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Educational and Professional Programme "Occupational Safety"          | <p>The programme corresponds to the Order of the Ministry of Education and Science of Ukraine No. 1076. It includes professional competencies in occupational safety management, industrial risk analysis, safety expertise, and operational planning of civil protection measures.</p> <p>The main disciplines are: professional foreign language, economics of occupational safety and technogenic safety, technogenic safety of facilities and modern production technologies, workplace ergonomics, emergency risk management, occupational safety management systems in industry, and public administration in the field of civil security.</p>                                                                    | <p>The programme is harmonised with the Council of Europe recommendations on the civic training of security professionals. It integrates instruction in leadership in crisis situations, the ethics of professional activity, and democratic decision-making in production contexts.</p> <p>The curriculum includes the following topics: "Civic Responsibility of an Occupational Safety Engineer", "Communication in a Multicultural Environment during Emergencies", and "Rights of the Employee and the Employer". Practical classes develop competencies related to cooperation, respect for human rights, and responsibility to society, in line with the framework of the International Association for the Evaluation of Educational Achievement, through simulations such as "Evacuation", "Incident Investigation", and "Collective Decision-Making in a Crisis".</p> |
| Occupational Health and Safety Educational and Professional Programme | <p>The programme is developed in accordance with the requirements of the Law "On Civil Protection of the Population", DSTU (State Standard of Ukraine, harmonised with the International Organization for Standardization standard) ISO 45001:2019, and the National Qualifications Framework.</p> <p>Professional disciplines include occupational health and safety, industrial sanitation, occupational psychology, risk management and occupational risks, technical expertise of production equipment, methods of control and measurement of harmful factors, occupational health and safety in construction and production, and audit and certification of occupational health and safety management systems.</p> | <p>The programme corresponds to European trends in Networking European Civic Education through the integration of the topics "Social Responsibility of a Citizen in the Field of Security" and "Culture of Security in the Community". The practical component includes training in joint decision-making, modelling of public consultations, and the analysis of European case studies (for example, the response of the ERCC system).</p> <p>It develops civic competencies related to participation in democratic processes concerning environmental decisions and responsibility.</p>                                                                                                                                                                                                                                                                                       |

**Source:** compiled by the authors based on Educational and Professional Programme "Ecological Safety" (2024), Educational and Professional Programme "Occupational Safety" (2024), Educational and Professional Programme "Occupational Health and Safety" (2025), Order of the Ministry of Education and Science of Ukraine No. 96 "On Approval of Higher Education Standards" (2024), Order of the Ministry of Education and Science of Ukraine No. 1076 "On Approval of the Higher Education Standard for Specialty 101 "Ecology" for the First (Bachelor) Level of Higher Education" (2018), DSTU ISO 45001:2019 (2019), Organisation for Economic Co-operation and Development (2025), Council of Europe (2018), International Energy Agency (2022)

The analysis of the content of educational programmes indicates that they generally comply with the state standards of Ukraine and contemporary European trends in civic education, as they provide for the integration of patriotic and ethical components into the professional training of students. The programmes are oriented towards the development of environmental and civic awareness, responsibility for occupational safety, environmental protection, and adherence to social norms. However, there is a lack of systematic integration of practical modules aimed at fostering civic engagement, critical thinking, and student participation in socially significant initiatives. The training courses do not sufficiently incorporate interdisciplinary approaches that would enable the integration of professional knowledge with civic and patriotic values. Therefore, further improvement of

the programmes requires the inclusion of components that ensure the practical application of acquired knowledge in the context of sustainable development, social responsibility, and active citizenship.

#### **Assessment of potential risks within the discipline "Environmental Safety and Civil Protection"**

Teachers and students are required to follow clear algorithms for assessing potential risks within the discipline of the Educational and Professional Programme "Occupational Health and Safety" (2025). These algorithms include identifying hazardous facilities, determining types of threats (physical, chemical, nuclear, or technological), assessing the likelihood of their occurrence and their potential impact on health, safety, and the educational process, modelling emergency scenarios, and developing and

applying preventive measures and action protocols in the event of accidents. Compliance with these procedures enables students to systematically develop risk management skills and a responsible attitude towards safety, while allowing teachers to effectively manage the learning process and evaluate the acquisition of theoretical knowledge and practical skills, thereby ensuring a safe and well-prepared

environment for emergency situations. Table 2 presents methods for identifying, assessing, and modelling risks at hazardous facilities, including nuclear power plants, chemical and oil and gas processing plants, fuel and ammunition depots, and hydraulic structures, together with specific examples of threats and recommendations for teachers and students regarding safe actions.

**Table 2.** Ways to indicate the risks of hazardous objects for teachers and students

| Dangerous object                 | Potential risks                          | Concrete examples for students and teachers                                                                                 |
|----------------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Nuclear power plant              | Radiation pollution, explosions, fires   | Radiation leak simulation, evacuation exercises, use of dosimeters during practical classes                                 |
| Chemical plants                  | Toxic gases, chemical burns, explosions  | Analysis of ammonia or chlorine leak scenarios, demonstration of personal protective equipment, development of action plans |
| Oil and gas refining enterprises | Explosions, fires, gas poisoning         | Simulation of tank fires, control of safe distances, use of gas masks                                                       |
| Fuel and ammunition depots       | Explosions, fires, debris                | Simulation of dangerous situations, practice of evacuation routes, instruction in handling hazardous materials              |
| Waterworks                       | Floods, dam failures, man-made accidents | Dam breach modelling, assessment of the risk of flooding of training laboratories, development of safety measures           |

**Source:** compiled by the authors

Table 2 demonstrates approaches to identifying risks at hazardous facilities for teachers and students, which enables the systematic introduction of potential threats to participants in the educational process, the practice of safe behaviour algorithms, and the development of practical skills for responding to emergencies. For each type of facility, including nuclear power plants, chemical plants, oil and gas refineries, fuel and ammunition depots, and hydraulic structures, specific risks are identified, ranging from radiation contamination and explosions to toxic gas releases and floods, and practical modelling examples are developed accordingly. Students perform exercises related to evacuation, maintaining safe distances, and using dosimeters and personal protective equipment, while teachers demonstrate accident scenarios and supervise the safe conduct of classes. This approach increases risk awareness, promotes the development of responsibility for one's own safety and the safety of others, ensures practical training in response algorithms, and creates conditions for integrating theoretical knowledge with real skills in the field of environmental safety and civil protection. As a result, it positively affects the effectiveness of the educational process and students' readiness to act in crisis situations.

Content analysis of the sources used makes it possible to identify key features of preparing students and teachers to work with potential risks in the field of environmental safety and civil protection. Course training materials systematise potential threats and classify them by type and level of danger, enabling students to form an initial understanding of risks and to assess their impact on the educational process. State regulatory documents on civil protection provide specific algorithms for action in emergency situations and establish criteria for safe behaviour and rules for the use of personal protective equipment,

which allows teachers to structure practical classes and to verify students' compliance with safety requirements. The International Atomic Energy Agency (2025) outlines methodological approaches to developing simulation models of hazardous facilities, providing opportunities to practise action algorithms in a controlled environment and to assess the effectiveness of preventive measures. At the same time, the United Nations Office for Disaster Risk Reduction (2021) offers structured recommendations on prioritising actions during crisis events and on assessing the probability and severity of their consequences, which enables the integration of international risk management standards into curricula and the development of students' competencies in planning and responding to emergencies.

These recommendations primarily include a clear definition of the sequence of actions during emergencies, assessment of the probability of specific threats, and evaluation of the severity of their consequences for people, equipment, and the environment. They also include algorithms for early risk detection, measures for accident and disaster prevention, evacuation planning, organisation of rescue and response teams, and monitoring compliance with safety procedures in educational and industrial environments. The combination of these sources creates a comprehensive basis for learning: one group of documents systematises threats and their impact on the educational process, another provides clear protection algorithms and risk assessment criteria, and a third supplements these with international methods and standards for modelling emergency situations. This approach enables students not only to master theoretical knowledge but also to acquire practical skills in predicting risks, assessing their probability and consequences, and developing effective safety measures during practical classes and in real professional environments.

### Recommendations and proposals for improving disciplines

Recommendations for improving academic disciplines encompass several key areas: updating programme content to include systematic topics in civic and patriotic education; integrating historical, cultural, and national contexts into professional subjects; strengthening interdisciplinary links between humanities, technical, and social science courses; introducing practical forms of learning aimed at developing social responsibility; establishing unified criteria for assessing the formation of civic and patriotic competencies; training teachers to work with patriotically oriented materials; and developing new educational modules and specialised courses that highlight examples of Ukraine's contribution to world science, culture, and technology. It is also advisable to expand cooperation between educational institutions and public organisations, museums, military units, and research centres in order to implement joint projects that foster an active civic position among students.

The need for these changes arises from the fact that the existing programmes do not sufficiently demonstrate the practical connection between professional competencies and civic responsibility. The inclusion of a patriotic component across all educational fields will ensure a holistic understanding of students' own role in national development. Updating programme content will promote not only the acquisition of knowledge but also the willingness to act responsibly, for example through the analysis of national innovations and participation in social initiatives or volunteer projects. The integration of historical and cultural contexts will enhance students' motivation to preserve national identity, as they will perceive a direct link between their profession and their contribution to strengthening the country. Interdisciplinary coordination of disciplines will support the formation of a broader worldview in which knowledge of statehood, security, human rights, and ethical responsibility becomes an integral part of every specialisation. This approach will eliminate duplication of topics and establish a coherent logic within the educational process. A strong practical component, such as participation in volunteer activities, environmental initiatives, or public research, will help transform theoretical knowledge into real experience of civic engagement. Training teachers to apply these approaches will improve the quality of teaching, as educators will be able not only to transmit knowledge but also to cultivate a patriotic stance through examples from their own professional practice.

The development of new educational modules and specialised courses will address gaps in existing programmes, particularly in relation to national defence capability, cultural heritage, and the technological development of Ukraine. This will enable students to recognise the importance of national achievements for global progress and foster a sense of pride in their country. It is recommended that topics related to artificial intelligence and intelligent systems focused on the analysis of environmental data be integrated into academic disciplines. The implementation

of this recommendation should include both theoretical and practical modules aimed at processing large datasets, interpreting the results of computer modelling, and using digital platforms to identify and predict environmental risks. This approach will contribute to the development of students' data-handling abilities, increase cognitive engagement, and strengthen critical thinking and analytical skills. The introduction of clear criteria for assessing civic and patriotic competencies will render this process measurable and controllable rather than purely formal. Finally, partnerships with non-university institutions will broaden the educational space and contribute to the formation of a socially active generation of young specialists who combine professional expertise with civic responsibility.

### DISCUSSION

The results of the study indicate that the implementation of environmentally oriented curricula in higher education institutions contributes to increasing students' awareness of global and local environmental threats, fosters a conscious attitude towards the natural environment, and promotes readiness to act in accordance with the principles of sustainable development. The observed increase in environmental competence is consistent with the findings of M. Alenezi *et al.* (2023) and G. Oliveira *et al.* (2021), who demonstrated the necessity of integrating the concept of environmental threats into the educational process in order to strengthen students' ability to understand the global challenges of sustainable development. It was found that, as a result of curriculum implementation, students developed a better understanding of the relationship between human activity and environmental conditions, as well as the consequences of the irrational use of natural resources. Similar conclusions were reported by H. Al-Samarraie *et al.* (2019), who established that environmental education increases the level of responsibility among future specialists and stimulates environmentally oriented behaviour. Likewise, the results correspond with the study by F. Campbell *et al.* (2022), which emphasised the positive role of environmental disciplines in developing students' systems thinking and their understanding of the interdependence between natural and socio-economic processes. Comparative analysis showed that, within the present study, emphasis was placed on the practical mastery of concepts related to environmental protection and responsible resource management, whereas the works of the cited authors predominantly adopted a theoretical and analytical approach. Nevertheless, the shared outcome confirms that curricula focused on environmental education contribute to the formation of value orientations and the development of civic consciousness.

The formation of environmental awareness was closely associated with the inclusion of modules on local environmental problems and the encouragement of active student engagement in environmental protection activities, which ensured deeper knowledge acquisition and increased the effectiveness of environmental education. This finding is

consistent with the conclusions of F. Campbell *et al.* (2022), and M. Sá & S. Serpa (2020), who emphasised the importance of students' perception of environmentally oriented academic content. The analysis of curricula demonstrated partial compliance with the state standards of Ukraine and European approaches to civic education; however, the level of integration of the patriotic component remains insufficient. Although the programmes include individual modules and topics aimed at fostering civic responsibility, they do not always ensure the systematic formation of national identity through academic content. In line with the observations of M. Ayu (2020), learning effectiveness increases when students are actively engaged in understanding social and cultural values, a conclusion also supported by the findings of this study. At the same time, as noted by K. Elumalai *et al.* (2021), educational programmes require flexible methodological solutions that promote student independence and initiative in combination with patriotic education. The results obtained are further consistent with the conclusions of N. Hidayati *et al.* (2020), who highlighted the importance of using national cultural values as a means of enhancing the relevance of educational content.

The most effective means of increasing environmental awareness were identified as relevant civil protection documents and civic education curricula that provide an interdisciplinary approach and, according to T. Gkrimpizi *et al.* (2023), serve as a key factor in shaping awareness of the global scale of environmental threats. Student involvement in collective problem-solving related to environmental issues fostered responsibility for environmental safety and readiness to respond to potential risks, in line with international initiatives in the field of sustainable development. Increased motivation for environmentally oriented activities was consistent with the conclusions of F. Guangul *et al.* (2020) and T. Rasul *et al.* (2023), who emphasised the importance of students' practical participation in collective projects and the development of a responsible attitude towards environmental safety. The identified trends indicate the need for a systematic approach to environmental education, which corresponds with the recommendations of Y. Villarreal Arroyo *et al.* (2023) and S. Rawas (2023), according to whom training should encompass cognitive, emotional-value, and behavioural components in order to develop practical competencies in the field of safety. Within the discipline "Environmental Safety and Civil Protection", teachers and students followed clearly defined algorithms for assessing potential risks, including the identification of hazardous objects, determination of threat types (physical, chemical, nuclear, or technological), assessment of the probability of occurrence and potential impact on health, safety, and the educational process, modelling of emergency scenarios, and the development of preventive measures and action protocols in the event of accidents.

Content analysis of the sources, including documents of the United Nations Office for Disaster Risk Reduction (2021), confirmed the importance of a systematic approach to risk modelling at critical facilities and the

integration of international risk management standards into curricula. These documents provided clear algorithms for assessing the probability and severity of potential accidents and defined priorities of action during emergencies, evacuation procedures, and the organisation of response teams. This enabled students to predict potential accident consequences, assess their impact on people, equipment, and the environment, and allowed teachers to monitor compliance with safety measures and to teach appropriate actions in real conditions. A comprehensive approach to student training, combining theoretical knowledge with practical exercises in risk assessment, was consistent with the findings of K. Basile *et al.* (2020) and M. Kuo *et al.* (2019), who emphasised the role of social experience and mutual support in shaping young people's responsible attitudes towards the environment. The study demonstrated that the integration of knowledge about potential threats with their practical modelling increased students' environmental awareness and formed competencies in risk prediction, impact assessment, and the development of effective safety measures. This result is consistent with the conclusions of K. Martzoukou *et al.* (2020) and contributes to a more conscious attitude towards environmental threats and to the development of critical thinking.

The study formulated recommendations aimed at improving the quality of environmental education and fostering responsible student behaviour. In particular, it is recommended to increase students' involvement in practical environmental initiatives, such as volunteer activities related to territory clean-up or participation in environmental monitoring. This recommendation is justified by its potential to enhance awareness of the consequences of human activity, to develop environmental responsibility, and to reduce stress and anxiety among students, as confirmed by the findings of M. Mofatteh (2020). Another recommendation concerns the expansion of analytical components in curricula, specifically through the inclusion of modules that demonstrate the relationship between technological processes and environmental change. This approach enhances students' critical thinking, supports the assessment of the ecological impact of innovations, and stimulates independent work with environmental data, which is consistent with the results reported by I. Sanusi *et al.* (2022). It is also necessary to integrate topics related to artificial intelligence and intelligent systems for the analysis of environmental data into training courses. This strengthens students' ability to work with large volumes of information, increases cognitive engagement, and promotes critical thinking, as confirmed by the findings of J. Southworth *et al.* (2023).

In addition, it is advisable to incorporate elements of local cultural and environmental values into course content. This enhances students' awareness of the importance of preserving local ecosystems and contributes to the formation of an ethical attitude towards nature, which correlates with the results of N. Hidayati *et al.* (2020). The implementation of these recommendations is necessary to ensure that the educational process not only transmits

knowledge but also develops socially responsible and environmentally conscious skills in students. In particular, Ukrainian programmes were found to demonstrate progress in fostering civic awareness, but to require deeper integration of the patriotic component in accordance with contemporary educational trends. The analysis showed that combining the theoretical study of environmental threats with practical analysis of environmental data contributes to the development of students' ability to predict the scale of potential risks and to assess their impact on populations, natural resources, and ecosystems. It was also found that the integration of digital monitoring tools, analytical systems, and artificial intelligence into the educational process enhances awareness of global and local environmental challenges and supports the development of responsible and environmentally conscious behaviour.

## CONCLUSIONS

The results of the analysis of the curricula demonstrate that they largely comply with the state standards of Ukraine and contemporary European trends in civic education. The programmes integrate patriotic and ethical components and ensure the development of environmental and civic awareness, as well as responsibility for occupational safety and environmental protection. At the same time, the programmes lack systematic integration of practical modules aimed at fostering civic engagement, critical thinking, and student participation in socially significant initiatives. Interdisciplinary approaches are insufficiently represented, which limits the integration of professional knowledge with patriotic and civic values. To enhance the effectiveness of the educational process, practical components should be introduced that enable students to apply the knowledge acquired.

Within the discipline "Environmental Safety and Civil Protection", the assessment of potential risks enabled students and teachers to systematically familiarise themselves with hazardous facilities and types of threats, including nuclear power plants, chemical and oil and gas processing plants, fuel and ammunition depots, and hydraulic structures. The performance of practical exercises involving the modelling of leaks, fires, toxic gas releases, and floods contributed to the development of skills in risk forecasting, the use of personal and collective protective equipment,

evacuation planning, and the formulation of action algorithms for emergency situations. Content analysis of the sources revealed that educational materials systematised threats and their impact on the educational process, state regulatory documents provided clear protection algorithms and risk assessment criteria, and international publications offered methods for modelling crisis event scenarios. This integration of theoretical knowledge with practical skills increased awareness of hazards, responsibility for the safety of others, and students' readiness to respond under real environmental and technogenic conditions.

Recommendations for improving academic disciplines focus on enhancing student training through the inclusion of topics related to civic and patriotic education, historical and cultural contexts, and interdisciplinary connections. Practical classes, participation in volunteer and social projects, teacher training, and the development of new modules make it possible to transform theoretical knowledge into real experience and to foster a patriotic position, responsibility for national development, and pride in national achievements. Unified assessment criteria and co-operation with non-university institutions ensure greater controllability of the educational process and support the development of socially active specialists. A limitation of the study is that the programmes were analysed at only one university, which reduces the representativeness of the findings and does not allow the conclusions to be unequivocally extended to other educational institutions. A perspective for further research is the investigation of the application of generative artificial intelligence models in the educational process of environmental safety and civil protection, particularly their influence on the development of analytical thinking, student autonomy, and the effectiveness of emergency scenario modelling.

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## **Підвищення обізнаності про екологічну безпеку серед здобувачів вищої освіти**

**Анотація.** Метою дослідження було здійснити аналіз навчальних планів та курсів з патріотичною складовою для підвищення обізнаності студентів про екологічну безпеку. Методологія дослідження включала теоретичний аналіз навчальних програм, контент-аналіз потенційних ризиків на небезпечних об'єктах та розробку рекомендацій щодо вдосконалення змісту навчальних програм. Навчальні програми забезпечували формування у студентів знань про екологічну безпеку, громадянську та патріотичну свідомість, поєднуючи теоретичні знання з практичними навичками реагування на надзвичайні ситуації. Разом із тим виявлено недостатню інтеграцію міждисциплінарних та практичних модулів, що обмежувало розвиток критичного мислення, активної громадянської позиції та застосування знань у реальному професійному та соціальному контексті. Контент-аналіз виявив, що навчальні матеріали і нормативні документи систематизують потенційні загрози, класифікують їх за типами та рівнем небезпеки, що дозволяло студентам формувати первинне уявлення про ризики та оцінювати їхній вплив на навчальний процес. Рекомендації щодо вдосконалення навчальних дисциплін передбачають оновлення змісту програм із включенням патріотичної та громадянської складових, посилення міждисциплінарних зв'язків, розробку нових модулів і спецкурсів, інтеграцію сучасних цифрових технологій та штучного інтелекту для аналізу екологічних даних, удосконалення критеріїв оцінювання громадянських компетентностей і розширення партнерства закладів освіти з громадськими інституціями. Реалізація цих змін спрямована на формування у студентів цілісного розуміння ролі фахівця в суспільстві, підвищення мотивації до збереження національної ідентичності, розвиток екологічної відповідальності, критичного мислення та громадянської активності як складових професійної підготовки. Практичне значення роботи полягає в тому, що її результати можуть використовувати викладачі дисциплін з екологічної безпеки та цивільного захисту для розробки навчальних програм і практичних занять із моделювання ризиків на небезпечних об'єктах

**Ключові слова:** студенти; викладачі; заходи захисту; цивільний захист; надзвичайні ситуації