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Scientific and methodological approaches to improving the level of environmental and labour safety as modern trends and prospects of higher education

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Abstract

Relevance. In the context of globalisation and the active development of the industrial sector, issues of environmental and labor safety are increasingly pertinent. The study addresses the need to develop methods for enhancing these aspects to safeguard citizen life and health, particularly through integration into higher education curricula.

Purpose. The purpose of this study was to explore modern methods for improving environmental and labour safety as foundational elements for national and higher education development.

Methodology. The study employed methods including analysis and synthesis, comparison, induction, and deduction to investigate the role of innovative technologies such as artificial intelligence, augmented reality, virtual reality, and monitoring sensors in enhancing environmental and labour safety.

Results. The study identified those innovative technologies, including AI, AR, VR, and monitoring sensors, play crucial roles in improving environmental and labour safety. Scientific and methodological approaches were proposed, encompassing educational initiatives among university students and industry employees, skill assessments, hazard monitoring teams, green infrastructure development, and the application of modern technologies for safety control.

Conclusions. The findings underscore the importance of integrating advanced technologies and methodological approaches into educational and industrial practices to enhance environmental and labour safety. Recommendations

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include better preparation of future professionals, optimization of professional practices, and improved performance of educational and research staff, benefiting both higher education institutions and industrial enterprises.

Keywords: environment; nature conservation; protection measures; innovative technologies.

Introduction

The safety of citizens and, specifically, employees of leading industries should be a priority for a modern state. Another priority of a modern state focused on international cooperation is environmental protection and ecological conservation, including in the context of active industrial development. The issue of improving environmental and occupational safety and health should be addressed at the level of higher education. Well-trained specialists with knowledge of environmental and occupational safety and health can increase safety measures and improve environmental and occupational health in their professional activities. This contributes to the development of the state, preservation of life and health of citizens, and environmental protection. Future specialists in industrial sectors are also at risk, as they need to be aware of environmental and workplace safety in the first place, which necessitates investigation into methods of improving environmental and occupational safety as a direction for the development of higher education.

D.Yu. Slivna and N.S. Yevtushenko [1], covering the areas for improving the safety of specialists in the machine-building industry, notes that the active development of the industry is conditioned by automation and mechanisation of production, which affects the environment and the increase in occupational injuries, and necessitates changes in approaches to occupational safety and environmental safety. Specifically, in their study, the researchers note that in 2021, 47 cases of occupational injuries due to environmental causes and 42 cases due to technical causes were identified in Ukraine. The researchers see the reason for such statistics in violations of safety regulations, lack of knowledge and experience, and unwillingness to comply with safety requirements at work, which demonstrates the need to introduce occupational and environmental safety measures at the level of higher education institutions in the training of future specialists.

In her dissertation on assessing the level of environmental safety, D.O. Krynska [2] notes that improving environmental safety is important for the sustainable development of the state and its industries. Environmental safety helps to reduce the incidence of morbidity, increase life expectancy, and improve its quality. This also applies to industrial workers, who are exposed to negative factors due to the specific features of their professional activities. The researcher believes that environmental safety should contribute to the protection of human health and nature conservation, which makes the study of approaches to improving environmental safety-relevant and necessary for modern Ukraine. L.M. Vasylyshyna [3] covered the specific features of increasing the level of environmental safety in the context of decentralisation and concluded that Ukraine has an increased level of anthropogenic and industrial pressure, which adversely affects the environmental situation of the state. The researcher considers the development of comprehensive approaches to environmental safety as a

solution to the problem, which will help restore the environment and maintain ecological balance.

Investigating electrostatic precipitators as a method of increasing the level of environmental safety, O.A. Antoshkin [4] notes that most modern technologies used to maintain environmental safety do not require considerable investments, which makes them quite affordable for all enterprises, as well as for learning by students of higher education institutions preparing for professional activities. Furthermore, modern technologies used for environmental safety can be beneficial for not only maintaining public health and preserving nature, but also for generating new raw materials for use, which can be the basis for environmental protection. According to the researcher, air purification using modern methods produces particulate matter that can be used to replenish raw materials. An analogous opinion is evident in the study of solid biofuel production according to environmental safety and labour protection measures conducted by L.E. Piskunova et al. [5].

They note that alternative energy sources are environmentally friendly and, in some cases, can even be infinite and renewable. This allows for preserving the environment while continuing to develop the industry and finding modern approaches to improving this industry without harming the environment and the health of workers and other citizens. The development of the state and its main industries is important and necessary, but according to I.M. Lepetan [6], who investigated the hierarchical levels of environmental safety, to preserve the environment, the state must take measures to preserve environmental and human safety, which is one of the highest priorities.

Thus, environmental and occupational safety should be the priorities of a modern state focused on sustainable development and international cooperation. However, safety measures can be violated by employees, which affects the environment and can contribute to an increase in workplace injuries. This necessitates the development of higher education in synergy with environmental and occupational safety measures as an essential part of preparing future professionals for their careers. Furthermore, the use of modern technologies, which are now largely available and do not require significant investments, is a prominent aspect of environmental and occupational safety. The analysis of recent studies has shown that the issue of improving environmental and labour safety is not addressed in terms of higher education but is analysed mainly in terms of industrial activity. However, it is precisely the development of higher education in this area that can be an effective method of preventing occupational injuries, preserving the health and life of citizens. Proceeding from this, the purpose of this study was to cover the modern approaches to improving environmental and occupational safety in the context of higher education.

Materials and Methods

To fulfil the purpose of this study, the following theoretical research methods were employed: analysis and synthesis, comparison, induction, and deduction. The method of analysis was used to cover the terms “environmental safety” and “labour safety”, to substantiate their interconnection and their impact on the development of the state and higher education, as well as to describe the factors that can affect safety in the workplace. This method helped to determine how environmental and labour safety measures affect the preparation of future specialists for professional activities and why it is important to develop students’ understanding of these processes.

The analysis also helped to describe the current state of environmental and occupational safety measures in Ukraine and the prospects for their further development. This method has been used to analyse environmental and labour safety and measures to improve them in other countries. The analysis helped to identify the main environmental issues that may affect the environment, as well as the health of citizens and their safety in their professional activities. Furthermore, the analysis method was used to cover the specific features of occupational and environmental safety among academic staff, as well as to describe potential hazards for students of higher education institutions, to describe the features of occupational safety of future specialists who received their education remotely and to identify priority ways of changing in this area. This method helped to cover the main modern technologies that can be used to improve environmental and occupational safety measures, as well as the areas of their application in improving these processes in higher education.

The method of comparison was used to correlate the terms “environmental safety” and “occupational safety”, to determine their relationship and its impact on the development of the state and higher education. This method was also used to correlate modern technologies that can be applied to improve environmental and occupational safety and health measures in both higher education and industry and to identify the most effective and affordable ones. The synthesis method was used to combine all the analysed views and opinions on improving environmental and occupational safety and helped to formulate scientific and methodological approaches to improving measures to improve them, which will be effective both in the development of higher education and in the development of the state and its industries.

The deduction method was also used to formulate approaches to improving the level of environmental and occupational safety, which helped to identify the general scientific principles of measures to improve environmental and occupational safety and, on their basis, to formulate new approaches that could be effective in this process. The method of induction was used to formulate the general conclusions of the study, to cover the prospects for further research, and to determine the practical significance of the study for the management of higher education institutions and industrial enterprises.

Results

In today’s world, the priority for present and future generations should be to maintain environmental and occupational safety and ensure decent living and working

conditions for every citizen. The processes of globalisation, modernisation, active development of industry and modern technologies affect the environment, labour conditions, and safety of employees in the workplace. The issue of labour safety also arises in higher education institutions, as future specialists cannot be sure of acceptable working conditions for themselves in the future due to distance learning and may not be fully familiar with the safety rules at their future workplaces.

Researchers consider environmental safety as a system of measures of various nature (legal, socio-economic, organisational) aimed at protecting the environment and eliminating factors that threaten it; a way to maintain ecological balance, a component of environmental protection [3]. At the same time, labour safety is considered as the creation of conditions for employees where their activities will be safe, protected, and aimed at preserving their health and life [7; 8], maintaining safety in the workplace, which affects the reduction of accidents, increasing productivity [9; 10]. Workplace safety can be affected by physical, chemical, biological, environmental, and psychosocial factors [11; 12; 13; 14]. This makes occupational safety interconnected with environmental safety: the state of the environment and the impact of physical, chemical, and environmental factors directly influence the ability to perform one’s job effectively and maintain one’s physical and psychological state to perform one’s duties and comply with safety measures for oneself and other citizens.

The main environmental problems that may affect the environment and, as a result, the health of citizens, their ability to effectively perform their duties, and receive decent working conditions, may include several factors. Air pollution affects the respiratory and cardiovascular systems. Water pollution affects the quality of drinking water and, consequently, the health of those who consume it. Soil pollution, caused by the accumulation of heavy metals and radioactive materials, affects the safety of food crops consumed by citizens. Violation of waste management rules, which pollutes the environment and can lead to diseases, particularly in urban areas where improper waste management is exacerbated by industrial impacts [11]. Environmental pollution and health problems affect the psycho-emotional state of citizens, which can reduce labour safety and should be considered and investigated.

The need to develop measures to improve environmental and occupational safety for academic staff and students, through the introduction of distance education and increased workload due to the actualisation of modern technologies, is becoming increasingly important. Academic staff have a great deal of responsibility and a considerable number of duties, which, apart from teaching students, include holding administrative positions, membership in university committees and commissions, and regular participation in research [9]. A modern academic should also be able to use modern technologies, which affect their health (specifically, vision, musculoskeletal system) and morale, as not all employees of higher education institutions are ready to actively use innovations.

Thus, it can be concluded that in the modern world, academic staff are at risk to the same extent as workers in

other industries, which necessitates the improvement of occupational health and safety measures in higher education institutions. Specifically, the problem of professional burnout among teachers is becoming increasingly relevant, which can be caused by various stress factors that reduce the effectiveness of professional activity, and affect the physical and mental state of the individual, thereby violating occupational safety. To improve the safety of academic staff, researchers suggest developing reasonable work schedules, promoting a healthy lifestyle among employees, and conducting special training that will help create a safe professional environment [12].

Students – future specialists in various fields – are also at risk. Apart from distance education, which can affect their employability, awareness, and availability of the necessary practical skills [15], an unfavourable factor of occupational and environmental safety for some categories of students is professional practice and laboratory work, which can both adversely affect the environment and the health of future professionals due to non-compliance with safety rules. Chemicals and biological materials that they may use during their professional practice or laboratory work are potentially dangerous for students of higher education institutions [16]. Proceeding from this, the task of the state and higher education institution is to provide academic staff and future specialists in all fields with a safe learning and working environment by following environmental and labour safety rules and by developing innovative approaches to improving them [17].

One of the approaches to improving environmental and occupational safety is educational work, the introduction of special programmes in the educational process and professional development [9]. These programmes should be aimed at informing students, academic staff, and professionals in various fields about environmental and occupational safety rules and raising awareness of these topics. Awareness-raising activities can take the form of training courses, workshops, distribution of booklets, posters, videos, and audio materials. During such courses, the target audience is made aware of the potential risks of their professional activities, and the rules for using tools, chemicals, biological materials, and other items that may pose a potential hazard.

Scientists also note that an effective method of improving environmental and occupational safety is a regular hazard audit, which will allow the organisation to identify potentially dangerous actions and activities during the learning/working process and take measures to minimise the possibility of their occurrence [9]. According to R. Prajapati et al. [12], a risk assessment can be most effectively conducted by a team that has analogous experience or that can create a risk mitigation strategy by analysing past incidents and injuries, both within its organisation and by considering the experience of others. In the same aspect, researchers are considering cooperation with healthcare institutions that can provide information on potential hazards in a particular organisation, conduct a

detailed analysis of them, and provide possible methods of eliminating them from a medical standpoint. Researchers also believe that one of the most effective methods of improving environmental and labour safety is to strengthen national and international policies in this area. International policies and programmes on environmental and occupational health and safety should be developed to help organisations provide a safe environment for learning or working. Furthermore, such measures should be taken by the heads of organisations based on the specifics of their activities.

Specifically, one of the methods that can improve environmental safety and that can be regulated by the management of organisations is the creation of green infrastructure [18]. This is particularly relevant for higher education institutions, as the emergence of green infrastructure there can be not only an effective method of improving environmental and occupational safety, but also a tool for learning. By planting plants on the territory of the educational institution, creating green corners, apart from cleaning the air from pollutants, and improving the morale and health of employees, students of agrobiological, plant protection, biotechnology, and ecology faculties can study them. Moreover, green infrastructure planning can be carried out by design students, which makes this method of improving environmental and occupational safety useful not only in environmental protection and ensuring decent working and learning conditions but also in the development of future professionals and the skills they will need in their career.

Scientists also believe that the use of modern technologies, including augmented reality and virtual reality, is an effective way to improve environmental and occupational safety. O. Krainiuk et al. [19] investigated the use of these technologies in improving environmental and occupational safety in Ukraine. The researchers noted that the use of augmented reality and virtual reality is an effective method of improving occupational safety due to the possibility of practising the necessary knowledge and skills in safe conditions. According to the researchers, the main areas of application of augmented reality and virtual reality may include identification of potential hazards, environmental, and labour safety education, and testing of knowledge and skills in these areas.

However, despite the effectiveness of modern technologies and the wide possibilities of their use in improving environmental and occupational safety, innovations can also have disadvantages that limit the possibility of their implementation in educational and work processes. Considering that innovative technologies are the current area of development of the state, its industries and, specifically, the education sector, it is advisable to conduct a comparative analysis of technologies and identify those that will be most accessible for implementation when improving environmental and occupational safety and health and the development of higher education (Table 1).

Table 1. A comparative analysis of the use of modern technologies in improving environmental and occupational safety

Technology	Methods of use	Advantages	Disadvantages
Augmented reality and virtual reality	Simulation of real situations that may arise during professional activity/study and be potentially dangerous; development of an algorithm of actions in case of a dangerous situation; testing of knowledge and skills of employees/students.	- the opportunity to practice practical skills in a safe environment; - the ability to understand the consequences of wrong actions in real situations, but without harm to life and health.	- high cost; - the inability to provide all educational institutions and organisations with the necessary equipment; - a frivolous attitude towards this technology, which may affect the effectiveness of the perception of the information received.
Artificial intelligence	Awareness-raising on environmental and occupational safety; environmental analysis using artificial intelligence sensors and, as a result, assessment of environmental indicators: air, water, soil quality, and natural disaster forecasting.	- the ability to automatically monitor environmental indicators, generate reports, and publish them; - speed of searching for the necessary information; - the possibility of using it to simplify the educational process and obtain the necessary information on occupational and environmental safety for both students and academic staff.	- the probability of error; - the possibility of full automation of processes, which can take away jobs.
Wearable monitoring devices	Improving the safety of employees/future specialists by monitoring their health indicators: pulse, blood pressure, sleep, and wakefulness; tracking the presence/movement of people in dangerous areas.	- the ability to warn professionals about potential hazards, both in their health and in their professional activities; - the ability to track the actions and movements of employees.	- certain violations of the privacy of persons wearing such monitoring devices; - the reluctance of citizens to wear such sensors; - difficulties in providing such sensors and a lack of software to summarise and store the information obtained from them.

Source: compiled by the authors.

Thus, the most effective innovative technology that can be used to improve environmental and labour safety is artificial intelligence, which has fewer disadvantages than other innovations, is accessible to all organisations and does not require large investments. Less accessible, but effective, are augmented reality and virtual reality, which, although they allow for practical skills training and knowledge of environmental and occupational safety, have certain limitations in use, as it is currently impossible to provide all organisations with the equipment necessary for their use. The least effective are wearable monitoring devices, which, although they increase occupational safety by tracking the health status of specialists and their location, violate confidentiality.

Summarising the measures analysed in scientific sources approaches to improving the level of environmental and occupational safety as modern areas and prospects of higher education were presented. The approaches include several strategies. First, conducting educational work on environmental and occupational safety. Second, monitoring potential hazards through the creation of a dedicated team. Third, regularly testing current knowledge and skills in environmental and occupational safety. Fourth, controlling environmental and occupational safety at both state and organizational levels. Fifth, establishing green infrastructure in cities and within higher education institutions. Lastly, utilizing modern technologies such as virtual and augmented reality,

artificial intelligence, monitoring sensors, and other available innovative technologies in efforts to enhance environmental and occupational safety.

Environmental and occupational health and safety education should be conducted at all levels: from higher education institutions as a method of training future professionals and preserving the health of academic staff to enterprises and other organisations. Awareness-raising activities can take the form of training, courses, and the development and distribution of booklets. Creating a special team to check the risks that future specialists may face during laboratory work/professional practice, research and teaching staff and employees of other industries during their professional activities is an effective method of ensuring occupational and environmental safety. A specially created team that can analyse potentially dangerous factors and provide an effective algorithm for their elimination should carry out monitoring. Namely, the special team may include medical workers, police officers, the State Emergency Service of Ukraine (SES) and workers from various industries with a certain length of service.

Checking up-to-date knowledge and skills is an effective method of preventing occupational injuries and violations of working conditions, as a person who is aware of their rights and responsibilities, knows the safety rules and can follow them has a minimised risk of environmental and occupational safety violations at their workplace. The development of special curricula is essential. Additionally,

controlling compliance with environmental and occupational safety conditions by employees at both state and organizational levels is crucial. Providing future specialists and employees with the necessary equipment is another vital aspect. Creating safe conditions for study and work forms the foundation for improving the quality of education and professional activity. Consequently, these efforts serve as the basis for the development of the state and higher education. The use of green infrastructure is a method of cleaning up polluted air, an opportunity for additional training for future professionals, and a way to improve citizens' health and psychological well-being. Green infrastructure includes greening of streets, creation of "green" corridors, creation of reservoirs, parks, squares with a lot of green spaces. In this aspect, it is vital to promote the care of existing green spaces, and it is advisable to involve future specialists in certain areas: biological, environmental, and landscape.

Thus, improving environmental and labour safety is a topical issue at the state level, as well as for representatives of those industries that are considered potentially hazardous. However, this study demonstrates the significance of these processes for the development of higher education: future specialists in various fields, as well as research and teaching staff, are also at risk of violating working and safety conditions. Furthermore, work to improve environmental and occupational safety should begin with the introduction of the necessary measures at the level of higher education, as the future generation is being trained in educational institutions to contribute to the sustainable development of the state. Therefore, the first step should be to maintain environmental and labour safety, as well as to ensure decent conditions for academic staff as the specialists who train the future generation. The second step towards the development of higher education and the state should be the formation of environmental and occupational safety basics for future specialists in various fields, which will help them to preserve not only their lives and health but also to carry out effective, safe professional activities for themselves and others in the future.

Discussion

The present study found that the main priority of a modern state is the security of its citizens and the creation of decent living and working conditions for them. H.C. Şimşek [20], H. Oh [21], and A. Santoso [22] agree with this, exploring sustainable development from the perspective of labour safety, noting that the well-being of citizens underlies sustainable development and is the key priority of the modern state. However, it was found that due to violations of safety rules, and low awareness of environmental and occupational safety, the number of occupational injuries is increasing, which R. Prajapati et al. [12] agree with. In their study of strategies to improve workplace safety in Nepal, these researchers noted that every year, about 2.3 million workers worldwide face workplace hazards due to non-compliance with regulations and lack of information in this area. E. Desmonda et al. [7] share a similar opinion, covering the impact of occupational safety on professional performance. Researchers note that the main cause of accidents in professional activities is low awareness of environmental and occupational safety, as well as

violations of safety rules. This highlights the need to develop the necessary skills at the level of higher education institutions when preparing specialists for professional activities. Additionally, there is a need for constant educational work and verification of employees' current knowledge.

W. Gao et al. [23], D. Zhang and X. Dong [24], who, while developing a system for assessing environmental safety in China following modern standards, noted that measures to maintain environmental and occupational safety should be implemented at all levels, including the highest – the state level. China has demonstrated an improvement in environmental and industrial safety assessment in recent years, making its experience important and useful for other countries and proving that the implementation of the necessary measures at all possible levels, including higher education, is a necessary step to preserve the environment, life and health of professionals.

The present study found that an effective strategy for improving the level of environmental and occupational safety is the use of modern technologies, which can be effective in preserving the environment and protecting the life and health of citizens. Discussing environmental safety, M.M. Karim et al. [25], who investigated floating power plants and the challenges posed by environmental and labour safety, note that to preserve the environment and the livelihoods of citizens, the use of modern technologies that will be safer is a necessity. However, the researchers note that alternative technologies used for energy production or other purposes must be tested and proven to be safe and not to pose a threat to the environment, workers, or other citizens, and do not require a great number of resources. M. Farid et al. [26], who covered the principles of using biotechnology to preserve the environment, share a similar opinion. The researchers believe that alternative modern technologies are an innovative solution for restoring, preserving, and improving the environment in times of active globalisation and industrial development and that environmental improvement underlies effective education and professional activity of citizens.

According to A. Adefemi et al. [11], investigated strategies for using artificial intelligence to preserve environmental and public safety, the use of innovations available in the modern world can be beneficial in several ways. These include monitoring air and water quality, tracking diseases within specific communities and their spread, implementing preventive measures, optimizing waste processing using computer vision, and assessing the risk of natural disasters in specific areas and times using geospatial analysis. By using special sensors, machine learning algorithms, satellite images, and information about a particular area in recent years, artificial intelligence helps to quickly respond to changes in the environment that disrupt environmental and occupational safety, making it an indispensable tool in improving them. Artificial intelligence can also be used to plan green infrastructure: designing its location, finding the most optimised planting areas, considering the climatic features and environmental needs of each community, as well as assessing their condition and effectiveness in protecting the environment.

K.S. Min [27] also noted the significant role of modern technologies in improving environmental and occupational safety, and explored ways to use smart technologies to build a smart city as a basis for improving environmental safety and preserving the health of citizens. K.S. Min [27] offers the use of technologies such as augmented reality, virtual reality, information modelling, 3D models, and drones. However, the use of drones under martial law in Ukraine may be limited.

The present study emphasised the need for educational work on environmental and occupational safety, starting with higher education institutions. C. Benson et al. [28] share a similar opinion. They note that one of the most effective methods of improving environmental and occupational safety is the introduction of specialized training programs. These programs aim to instil in future professionals an understanding of the importance of preserving the environment, compliance with safety regulations during professional practice, and the ability to recognize situations hazardous to the environment and people. Furthermore, they emphasize the importance of understanding the proper actions to prevent or minimize the negative impact of such situations.

According to the researchers, future employees should develop a culture of safety, which they will pass on to the next generations, which will increase the life expectancy of current and future generations, improve their quality of life and, as a result, the development of the state, which correlates with the findings of the present study. This proves the significance of raising the level of environmental and labour safety as a basis for the development of higher education. Furthermore, according to C. Benson et al. [28], changes should also be implemented at all levels of enterprises: from the design of the enterprise to the efficient operation and prompt maintenance of equipment, which is a preventive measure against occupational injuries and helps avert environmental pollution.

In their study of the impact of environmental and occupational safety training on the culture of safe behaviour, S.H. Choi et al. [29] agree on several points. They emphasize that safety training, awareness-raising on this topic, and the ability to identify and prevent hazards are crucial for the development of the state and its industries. Additionally, these measures play a vital role in preserving the environment, as well as in ensuring the life and health of citizens. The researchers believe that awareness of danger should be formed through education, which is consistent with the approach proposed in the present study. The study of the impact of education on the probability of occupational accidents by K. Jang and W. Ha [30] also showed that in enterprises where employees were aware of environmental and occupational safety measures and where periodic checks of the relevance of this knowledge were carried out, accidents occurred less frequently or not at all.

One of the innovative methods proposed in the present study to improve environmental and occupational safety is wearable monitoring sensors. H. Fugate and H. Alzraiee [31] investigated their effectiveness, concluding that such technologies are effective and can be used to improve the safety of workers in various industries, specifically by tracking the physiological state of workers, identifying

hazardous areas, and the proximity of hazardous areas. However, according to the researchers, not all employees are ready to use such technologies, which is consistent with the findings obtained in the present study. This study also identified the need to improve environmental and occupational safety for the development of higher education and described the risks faced by academic staff and future professionals in various areas. It was found that during professional practice, laboratory work, students may encounter potential hazards. N.S. Sukri et al. [32] agree with this, investigating environmental and occupational safety during students' laboratory activities.

The researchers note that there is admittedly a possibility of accidents in higher education during professional practice or laboratory activities caused by violation of safety measures or lack of awareness of them, which proves the need for greater attention to environmental and occupational safety measures in higher education institutions. Exploring the development of higher education as a basis for improving occupational safety, T.A. Mouneer [33] notes several interrelations. They emphasize that environmental safety, occupational safety, and higher education are closely linked. The development of higher education and the quality training of future professionals for their professional activities contribute significantly to maintaining environmental and occupational safety. Simultaneously, ensuring quality environmental and occupational safety also enhances the effectiveness of higher education and promotes the health and well-being of educators. These findings correlate with the conclusions drawn from the study.

Therefore, improving the level of environmental and labour safety should be a priority for the modern state and the basis for sustainable development. Furthermore, the significant role of these processes in higher education was proved: ecology and decent working conditions contribute to an effective educational process, while an effective educational process forms an understanding of the importance of environmental and labour safety among future professionals, which minimises the risk of occupational injuries and helps to preserve the environment, life and health of citizens. Thus, measures to improve environmental and occupational safety should be implemented at all possible levels, starting with higher education, as the basis for training future professionals for safe professional activities, through educational work, and testing of relevant knowledge and skills on safety rules. Modern technologies can contribute to the efficiency of this process, but their use must be substantiated, and their effectiveness must be tested and proven. By considering all the risks, qualitatively preparing specialists for their future professional activities and taking care of the safety of the environment and citizens, an effective, sustainable development of the state can be achieved.

Conclusions

This study covered modern approaches to improving the level of environmental and labour safety as a condition for the development of the state and higher education. The study defined the term "environmental safety" as a system of measures of various kinds aimed at protecting the environment and eliminating factors that pose a threat to it. Additionally, it defined the term "occupational safety" as

the creation of conditions for employees that ensure their activities are safe, protected, and aimed at preserving their health and life. These conditions significantly contribute to reducing accidents and increasing labour productivity.

The interconnection of environmental and labour safety is conditioned by the fact that both processes are aimed at preserving human life and health and protecting the environment. Furthermore, the state of the environment and the impact of certain (physical, chemical, environmental) factors on the human body affect the ability to perform the necessary activities and to follow safety measures for themselves and other citizens. It was found that by adhering to environmental and labour safety, safety, and using modern approaches and methods to improve environmental and labour safety, it is possible to reduce the number of occupational injuries, and reduce environmental pollution, which will improve the quality of life of citizens and contribute to the development of the state.

Equally significant is the observance of environmental and labour safety in educational institutions, specifically during the training of future specialists for professional activities and during their professional practice, which will help to form a healthy, conscious, competitive generation capable of developing the state and its industries. The prospects for the development of higher education in this area include creation of decent working conditions for academic staff, which will influence the preparation of

future specialists for safe professional activities for them and others and ensure safety during their professional practice and laboratory activities.

The scientific and methodological approaches to improving the level of environmental and labour safety include conducting educational work, checking current knowledge on safe behaviour in the workplace, creating risk monitoring teams, developing and creating green infrastructure, monitoring environmental and labour safety at the state level, and using modern technologies. Modern methods that can be used to improve environmental and occupational safety include augmented reality and virtual reality, artificial intelligence, wearable monitoring sensors, and drones. Prospects for further research are to test the effectiveness of the described innovative technologies in improving the level of environmental and occupational safety, as well as to analyse the specific features of compliance with environmental and occupational safety among future specialists during their professional practice and laboratory activities.

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Conflict of Interest

None.

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Науково-методичні підходи до підвищення рівня екологічної безпеки та безпеки праці як сучасні тенденції та перспективи вищої освіти

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Анотація

Актуальність. В умовах глобалізації та активного розвитку промислового сектору все більшої актуальності набувають питання екологічної безпеки та безпеки праці. Дослідження спрямоване на розробку методів посилення цих аспектів з метою збереження життя та здоров'я громадян, зокрема, шляхом інтеграції в навчальні програми вищої освіти.

Мета. Метою цього дослідження було вивчення сучасних методів підвищення екологічної безпеки та безпеки праці як фундаментальних елементів розвитку національної та вищої освіти.

Методологія. У дослідженні використано методи аналізу та синтезу, порівняння, індукції та дедукції для вивчення ролі інноваційних технологій, таких як штучний інтелект, доповнена реальність, віртуальна реальність та датчики моніторингу, у підвищенні екологічної безпеки та безпеки праці.

Результати. Дослідження показало, що інноваційні технології, зокрема штучний інтелект, доповнена реальність, віртуальна реальність та датчики моніторингу, відіграють вирішальну роль у підвищенні екологічної безпеки та безпеки праці. Запропоновано науково-методичні підходи, що охоплюють освітні ініціативи серед студентів університетів та працівників промисловості, оцінювання навичок, команди з моніторингу небезпек, розвиток зеленої інфраструктури та застосування сучасних технологій для контролю безпеки.

Висновки. Результати дослідження підкреслюють важливість інтеграції передових технологій і методологічних підходів в освітню та виробничу практику для підвищення екологічної безпеки та безпеки праці. Рекомендації включають кращу підготовку майбутніх фахівців, оптимізацію професійних практик та підвищення ефективності роботи науково-педагогічних працівників, що принесе користь як вищим навчальним закладам, так і промисловим підприємствам.

Ключові слова: довкілля; охорона природи; природоохоронні заходи; інноваційні технології.