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**EDUCATION IN THE FIELD OF CLIMATE CHANGE ADAPTATION
AS AN INTEGRAL PART OF ACHIEVING SUSTAINABLE DEVELOPMENT GOALS**

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Abstract. Every year, the problem of globalisation of environmental challenges is becoming more and more noticeable, with climate change taking priority place among them. The lack of a sufficient number of climate-related disciplines in Ukrainian educational institutions limits the number of environmental experts who will be able to effectively implement climate change adaptation measures and implement the world's best practices in reducing greenhouse gas emissions through decarbonisation of energy, implementation of energy-saving equipment and transition from fossil fuels to renewable energy sources. It has been determined that in recent decades the number of scientific publications focused on the development of educational processes in the context of climate change has increased rapidly. It has been found that the main directions of implementing climate education in educational institutions are to provide quality school education to rethink the priorities of an environmentally friendly lifestyle and to form highly qualified specialists at universities who will be able to implement climate change adaptation projects in various sectors of the economy after obtaining a quality and holistic education at universities.

Keywords: education, students-ecologists, climate change, adaptation, mitigation.

1. Introduction

The challenges we are facing today make the problem of climate change and the consequences that result from it very acute. Insufficient understanding of the problem and ignoring the impending threat leads to a loss of time and the opportunity to implement

projects that will reduce the rate of climate change, mitigate the impacts and adapt society to climate change within the framework of sustainable development (IPCC, 2021). At the same time, sustainable development of society involves the synergy of society, ecology and economy, which cannot be achieved without proper education and a deep understanding of the processes taking place in the environment. The harmonious and mutually beneficial combination of all three components of modern society is the key to preserving life and ensuring the well-being of humanity for future generations (UNESCO, 2017). Therefore, an essential stage in ensuring high-quality of education is to raise awareness of the sustainable development goals and the importance of their proper implementation, which is a prerequisite for understanding the responsibility for the future of all categories of the population without exception (Fuso Nerini et al., 2019, Liu et al., 2021). Realizing that future generations will play a crucial role in the economy of the 21st century, Ukraine, like the European Union, focuses on raising awareness of this issue among a wide range of pupils, students and society. Indeed, currently, the main problem in implementing many energy-saving, climate or environmental projects is not only the lack of a sufficient number of qualified employees, but also the inadequate level of public support. Particular attention should be paid to sustainable development issues and to broadening the awareness of people, from

secondary school students to qualified professionals and ordinary citizens, to determine the right priorities for further development. Starting from primary education, children should be aware of the main environmental, social, cultural and economic impacts of climate change at all levels, about prevention, mitigation and adaptation strategies at different levels, and be able to identify their individual environmental impact. Gaining such basic knowledge about climate change in schools can increase the number of informed people who will implement and promote the use of environmentally friendly technologies and reduce greenhouse gas emissions (Dawson et al., 2022, Cordero et al., 2020).

A detailed assessment of the environment and climate change in Ukraine is reflected in the European Commission's 2023 Country Report on Ukraine (Ukraine report 2023, 2023) The European Commission noted a "certain" level of "readiness" of Ukraine in the environmental and climate sectors, highlighting "good" progress on environmental issues (adoption of horizontal legislation, water quality, waste management, chemicals and noise legislation) and limited progress on climate issues.

The Report's significance lies in the fact that the European Commission has identified key reforms in this sector that are expected from Ukraine in 2024:

- ✓ Cross-cutting reforms:
 - ensure cross-sectoral integration of environmental and climate measures into the country's reconstruction plans;
 - define green reconstruction strategies for key sectors of the economy;
 - prioritise EU standards and legislation to which priority adaptation measures will be implemented in the National Programme for the Adaptation of Ukrainian Legislation to EU Law.
- ✓ Environmental reforms:
 - adopt primary and secondary legislation to continue the reforms initiated in water management and waste management;
 - adopt a law on environmental control and legislation to harmonise with industrial emissions legislation.
- ✓ Reforms in the climate area:
 - adopt a climate law;
 - initiate an update of the long-term low-carbon development strategy in line with the EU's 2030 climate and energy policy.

Reforms in the environmental and climate areas should focus not only on the adoption of relevant legislation, but also on its implementation and

strengthening the administrative, financial, supervisory and human resources capacity of public authorities and local governments to implement the necessary reforms and attract investments. According to the European Commission, Ukraine's weak administrative capacity in the field of environment and climate is a major challenge.

In the climate area, the European Commission has highlighted efforts to be focused on:

- developing a strategy and action plan for the implementation of the updated Nationally Determined Contribution (NDC)
- developing a National Energy and Climate Plan; accelerating the implementation of the Decarbonisation Roadmap for the Energy Community Contracting Parties, in particular, the introduction of an emissions trading system;
- alignment of the future national climate strategy and climate law with the EU legislation adopted as part of the Fit for 55 package.

That is why only deepening people's understanding of the need to urgently solve this problem, expanding priorities and forming awareness of mutual responsibility of all categories of the population for the environment and the future of humanity will help to determine the main vector of efforts to promote sustainable development of society. It should be remembered that climate change is a global challenge that has no national borders or boundaries and affects all of humanity. Understanding this, most countries are open to cooperation in the field of climate change, implementation of common ideas and practical solutions through the transition to a green economy, use of alternative energy sources, decarbonisation of the economy etc.

Implementation of any initiatives requires the involvement of specialised experts and professionals, and this, accordingly, requires ensuring high-quality education of students in higher education institutions. However, the number of climate-oriented disciplines taught in Ukrainian universities is quite low. On the other hand, young people are the driving force and future of society. Therefore, it is very important to increase the number of educational programmes focused on deepening students' knowledge of climate change and sustainable development, climate change mitigation and adaptation. An increase in the number of climate-oriented specialists will help to create a basis for researching the impact of climate change on economic sectors and developing effective strategies for economic development under the new conditions.

2. Theoretical part

Every year, the problem of globalisation of environmental challenges is becoming more and more noticeable, with climate change taking the priority place among them. Until recently, this problem was mainly raised at the level of the scientific community and specialised experts in this field. However, the threatening rate of change in global temperature, rapid climate change, and the increasing number of abnormal events and natural disasters indicate that the solution to this problem must be brought to a higher, global level. It is already well established that this problem requires a comprehensive solution involving scientists, specialised professionals, educators and humanity as a whole.

The global nature of this problem makes it impossible to take separate decisions by different

states, and requires a synchronised, harmonious and balanced decision on the actions of each individual state or humanity as a whole. This can only be realised through the introduction of the latest technologies and the transition of the economy to a new environmentally friendly level of functioning, which can be ensured by obtaining high-quality comprehensive and holistic education to broaden people's understanding of this problem and increase the number of specialised professionals in this area, as well as by engaging specialists in climate-dependent industries and the public to create conditions and support for best European practices in this area.

According to the results of research, the number of scientific publications focusing on the development of educational processes in the context of climate change has significantly increased in recent decades (Fig. 1).

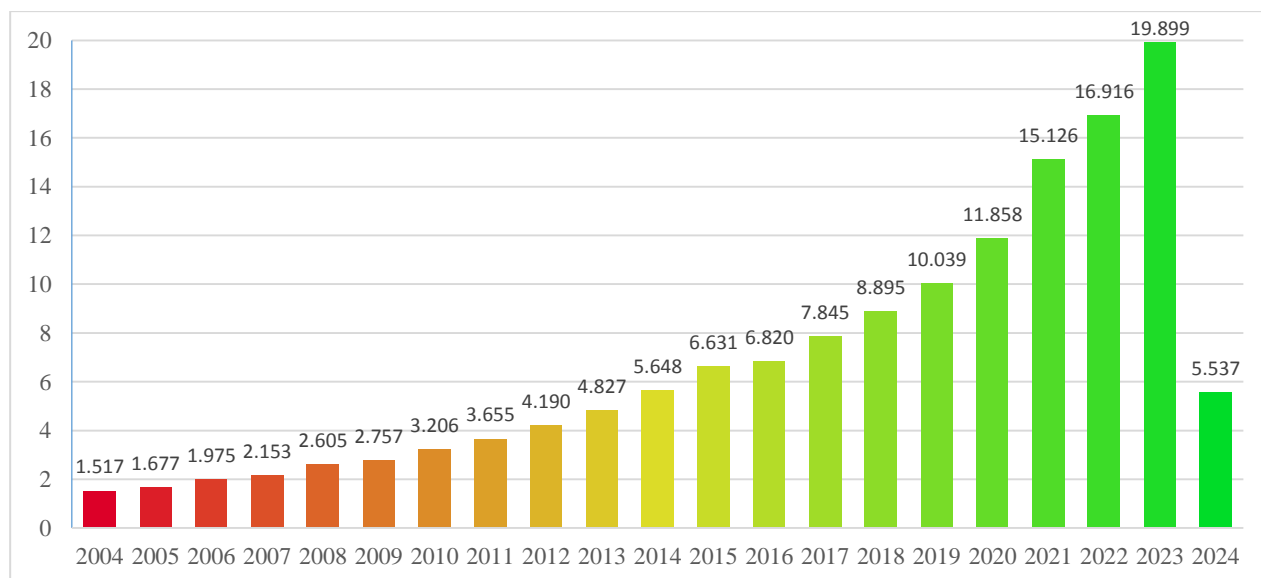


Fig. 1. The number of scientific publications on the request “climate change education” in the online platform for scientific publications ScienceDirect over the last 20 years (in thousands per year)

The obtained education should encourage people to re-evaluate their own values and live their own lives in accordance with the goals of sustainable development and climate change mitigation (Tolppanen, 2022).

Therefore, an important direction in the development of modern education should be a vector focused on raising public awareness of climate change and its main impacts. The main attention should be paid to reviewing the knowledge of school and university students, as well as scientists and environmentalists, to broaden their outlook on the use of the latest technologies in climate change adaptation

and mitigation for both the population and the economy as a whole. After all, deepening the knowledge of students, scientists and society as a whole contributes to the achievement of sustainable development goals, their content, ways of implementing them in the framework of climate change adaptation and preserving an environmentally friendly environment for future generations. This area is especially relevant and important to implement today. It promotes the use of renewable energy sources, responsible consumption and adherence to the principles of a green economy, which is in line with the main vector of societal development in the European Union and the whole world. This, in turn,

will enable the full and comprehensive implementation of environmentally friendly technologies for climate change adaptation in Ukraine in the future, based on the best international practices.

The lack of a sufficient number of climate-related disciplines in educational institutions limits the number of environmental experts who will be able to effectively implement climate change adaptation measures and implement advanced European policies to reduce greenhouse gas emissions through energy decarbonisation, the implementation of energy-saving equipment and the transition from fossil fuels to renewable energy sources. Providing quality education with the best European practices will allow Ukrainian specialists to fully contribute to solve the common problem of climate change and create safe living conditions on the planet in the future.

In addition, it is important to engage participants in the educational process to deepen their knowledge of the possibilities of using digital technologies and their application in education. Today, we have enormous opportunities to work in the world of digital technologies. Databases on climate change and its impacts, computer applications, digital maps, and real-time online monitoring of the environment are just a small part of what modern digital technologies provide us with. This approach ensures access to education for all people, including people with disabilities, and expands the scope of receiving, searching for and transferring information between user groups. There is no longer a need to travel thousands of kilometres to meet colleagues or share information. With computer technologies, you can reach a large audience of listeners almost anywhere in the world. Computer technologies make it possible to engage scientists from other European countries in cooperation and communicate easily with them. An important aspect of the digitalisation of the educational process is its environmental friendliness and the ability to follow the 12th Sustainable Development Goal, namely responsible consumption, as it minimizes the need to use paper booklets, leaflets, manuals, notebooks, and organize the whole process using computer technologies. In this way, we preserve forests and the environment, reduce the burden on the economy, and make a small contribution to the Green Economy of Europe and the world.

Ensuring ecological education for the general population, equal access to education for all people without exception to raise their awareness of ecological problems of society and broaden their understanding

of the sustainable development goals, their respective roles and the need to implement these goals in everyday life is the key to their support in implementing environmental initiatives and projects, which in turn is an important step towards successful implementation of changes and transition to climate neutrality by 2050.

In addition, it is equally important to provide ongoing education on climate change issues, starting at school. Deepening children's awareness, identifying priorities for preserving environmental quality, understanding the processes and effects that occur, create environmentally responsible students who are ready to work and implement their ideas in climate change adaptation. Students who choose to continue their education and become experts in the implementation of climate change adaptation and mitigation technologies have more opportunities to become highly qualified professionals in this field.

Having analysed the state of educational programmes, a conclusion could be made that there are not enough educational programmes on climate change and sustainable development in Ukraine, which consequently limits the integration of the issues of climate change, sustainable development and European climate policy into existing curricula. Therefore, students often lack a holistic understanding of the scientific basis of climate change and its consequences, ways to implement the European approach to climate policy to adapt all sectors of life to these changes, and the main criteria for environmentally safe and socially oriented development of society. Insufficient technological training in climate change adaptation caused by insufficient knowledge reduces the professional qualities of future professionals and decision-makers in dealing with climate change issues in the application of advanced technological solutions to adapt various sectors of the economy to climate change and reduce greenhouse gas emissions. Students-ecologists and specialists in climate-dependent industries lack specialised training in the selection of specific technological solutions for adapting various sectors of the economy to climate change, mitigating its effects, ensuring the use of green technologies and sustainable development of society.

Limited public engagement, lack of informed public discourse reduces public support for the implementation of energy-saving and climate-friendly technologies and minimises public participation in dealing with climate change issues, etc.

That is why increasing the number of disciplines focused on deepening knowledge of climate change and ways to adapt to climate change through the exchange of best practices with EU countries, especially for students-ecologists, is important and a priority task for the further development of education in Ukraine. It is impossible to underestimate the enormous contribution to dealing with climate change made by educational institutions, such as those in the European Union. Many leading universities in Europe and around the world are developing their own strategies to engage students in measures to reduce greenhouse gas emissions, transition to innovative technologies and achieve sustainable development goals. This only shows once again how important it is to understand the value of each individual, organisation and state in this process.

3. Results and Discussion

Integration of Ukraine into the EU in the field of environment involves the implementation of national and international programmes focused on ensuring social justice in the area of climate change. Such programmes should include the adaptation of regulatory legislation to EU standards, the development of digital technologies, the creation of a national system for the purchase of CO₂ emission quotas, and the promotion of ongoing education and a high level of

professionalism among environmentalists, which should be implemented within the framework of existing training programmes for climate change specialists. Therefore, it is very important to ensure the formation of qualified environmental specialists who meet the European labour market demand and to raise public awareness of European and global experience in the field of climate change.

The special role of universities is to develop environmentally aware, qualified climate change professionals who are prepared to deal with scientific, social, environmental and economic challenges on the path to climate change adaptation and mitigation (Molthan-Hill et al., 2019, Leal Filho et al., 2023). Ensuring ongoing education and an interdisciplinary approach will ensure the formation of highly qualified professionals who will be able to implement projects in various sectors of the economy, based on the principles of sustainable development and improving the quality of the environment through the rational use of natural resources and mitigation of climate change.

In the short term, by engaging a large number of students in interdisciplinary education on climate change adaptation, we will get professionals who are able to implement projects in various climate-dependent sectors of the economy. In the long term, we get aware citizens who will share and implement their experience in reducing greenhouse gas emissions and living an environmentally friendly lifestyle.

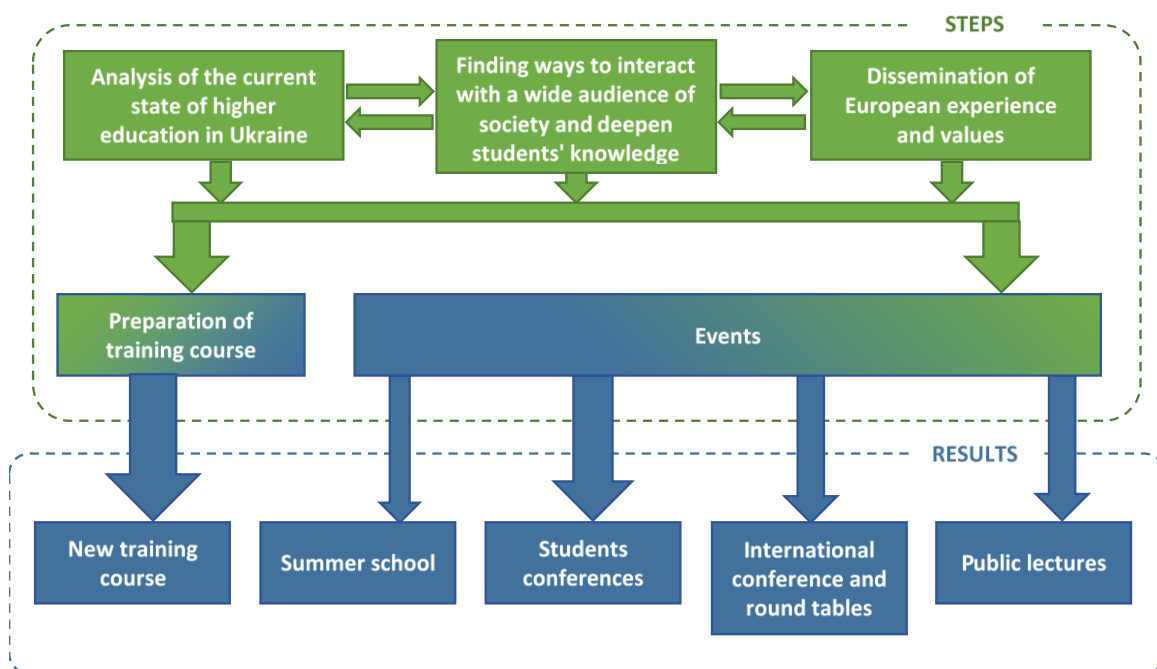


Fig. 2. Possible ways to engage students in active study of climate change issues with the involvement of the wide public

It is important to increase the number of representatives of government and business, as well as NGOs, participating in roundtables and conferences, which will draw attention to the global problem of climate change and raise awareness of the target audience about climate change issues and possible ways to adapt to climate change and mitigate the effects of climate change. This will create conditions for supporting and implementing climate change projects and expanding cooperation between different sectors of the economy. After all, sustainable development of society is only possible with the interaction of all spheres of life, without exception.

Only at the university level students can be fully engaged in the study of climate change through a combination of theoretical learning and practical skills, which contributes to better learning and the development of professional skills of students-ecologists. On the other hand, an interdisciplinary approach and the involvement of students in various events with scientists, stakeholders and environmental NGOs allows to obtain a holistic picture of the level of knowledge required for future professionals (fig. 2).

4. Conclusions

Considering the urgency of the climate change problem and the low awareness of people, an important stage in the development of education in Ukraine is the introduction of disciplines into educational programmes that will ensure an interdisciplinary approach to learning and deepen students' knowledge of climate change, adaptation of all spheres of life to climate change and promote adherence to the principles of sustainable development of society. Taking into account that the main forecasts of both climate change and sustainable development goals have a long-term perspective, the creation of educational programmes is a mandatory step for the full development of all areas of education. Over time, almost all climate-dependent sectors of the economy will require specialists who are not just experts in their field, but also have the skills and can be useful in dealing with issues related to climate change and industry adaptation to these changes.

On the other hand, it is also very important to increase the number of climate-related courses for students-ecologists. After all, climate change problems are based on environmental issues, namely the emission of pollutants into the environment as a result of anthropogenic activities. And the implementation of new academic disciplines in educational programmes will eventually ensure a sufficient level of training for students-ecologists to implement measures to mitigate climate change and adapt economic sectors to climate change.

The organisation of annual student conferences, roundtables and public lectures on climate change and the involvement of a large number of participants will create conditions for the exchange of experience between representatives of various professions, NGOs, students, scientists and international partners. The invaluable European experience and the opportunity to implement advanced European technologies in Ukraine are the basis for further development of this area in Ukraine.

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