“Assessing the ability of Ukrainian higher education to offer key skills of tomorrow”

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SPECIAL ISSUE "UKRAINIAN UNIVERSITIES IN NEW REALITIES: 10 YEARS OF WAR"

Oksana Zakharova (Ukraine), **Liudmyla Usyk** (Ukraine), **Maryna Petchenko** (Ukraine)

ASSESSING THE ABILITY OF UKRAINIAN HIGHER EDUCATION TO OFFER KEY SKILLS OF TOMORROW

Abstract

Ukraine must search for efficient tools to accelerate the economic recovery in the post-war period. The workforce equipped with future skills is globally considered to be able to accelerate the pace of innovative growth and achieve the goals of Industry 4.0. This study aims to identify key skills of tomorrow and outline the ways in which these skills can be strengthened at Ukrainian universities. The skills of tomorrow that the Ukrainian standard for higher education recommends the universities include in the existing and new educational programs in various specialties were divided into five groups depending on their nature. Moreover, they were mapped following sustainable development goals to comprehensively assess their ability to promote each goal. Thus, the concept of a 'future skill' has been defined to contain aspects such as sustainability, skills, Industry 4.0, energy, education, energy efficiency, productivity, and creativity. The relationships between each future skill and its ability to facilitate sustainable development goals were described, and possible problematic areas were identified. Finally, the paper revealed that the skills able to boost the economy, which is specifically relevant for the post-war recovery of Ukraine, are not satisfactorily represented in Ukrainian higher education. Therefore, to make the Ukrainian higher education system a decisive factor in post-war recovery, it should shift the focus from solely hard skills to the skills of the future.

Keywords Industry 4.0, sustainable development, university, research, standard of higher education, knowledge, economy, innovation

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INTRODUCTION

The critical condition of the Ukrainian economy today is shaped by four factors. The first factor is the full-scale war. The second factor is related to the negative dynamics of demographic indicators, which has resulted in the annual trend of population reduction since 1991. The third factor is the economic crisis, which had a deteriorating effect on the quality of life of the population in the pre-war period (1991–2022) and which acquired additional destructive aspects during the war. The fourth factor is related to the fact that the Ukrainian economy relies heavily on the natural resource potential, metallurgical and chemical production, which entails significant environmental risks. Therefore, in order to retain a stable position in the market and secure positive development trends in the future, the management of various Ukrainian enterprises should search for effective tools and levers that will allow them to realize their strategic goals.

The Ukrainian economy survived the three wartime years solely owing to the comprehensive assistance of the partner countries. Based on the statements expressed by the world leaders that fully support Ukrainians in their aspiration to preserve the right to territorial integrity, financial aid to Ukraine will continue in the post-war peri-

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od in order to bring its economy out of the protracted crisis. However, external investments should not be considered the only instrument of restoration, development, and fundamental transformation of all production, economic, and management processes. Ukraine has to start changing the external surrounding conditions by changing the internal environment, that is, by ensuring that the country's population acquires the skills necessary to achieve a significant increase in the level of productivity and labor efficiency at each workplace. Considering the pace at which technology updates and modernizes globally, Ukrainians should focus on those skills that will be relevant in the future. That is, Ukrainian society faces the challenge of making a powerful technological breakthrough in a relatively brief period, transitioning from a resource-intensive type of economy to a knowledge and information economy. This should create a solid basis for successfully implementing sustainable development goals within the country in the post-war period and overcoming the consequences of the problems listed above. Higher education is supposed to be a crucial driving force of these processes, and therefore it is crucial to diagnose the ability of higher education in Ukraine to reproduce the key skills of tomorrow.

1. LITERATURE REVIEW

The skills of tomorrow, as a fundamental condition for implementing sustainable development goals, have received considerable scientific interest in recent years. The researchers approach the problem from two perspectives. The first strand has sought to substantiate the need for future skills by analyzing the workplace requirements directly. Thus, to ensure sustainable production and increase the energy efficiency of the most energy-intensive sectors of the country's economy, Akyazi et al. (2023) prove the need for the personnel in these sectors to acquire the skills of working with the latest digital systems and technologies. Branca et al. (2022) justify the need for the workforce in energy-intensive industries to acquire initiative-taking skills, including energy efficiency, for the country to approach the status of a green economy.

Siriwardhana and Moehler (2023) have proved that it is possible to increase the productivity of the country's construction industry through disseminating skills among employees in the field of Construction 4.0 and supplementing theoretical knowledge with its consolidation in practice. Assylbekov et al. (2021) claim that the lack of skills and experience are the critical obstacles to sustainable development of the construction industry, which also slows down the spread of green buildings. Akyazi et al. (2020) and Helmi et al. (2024) determined that, in order for the civil construction sector to satisfy the demands of digital transformation, sustainability, climate change, and energy efficiency, it needs an inflow of a highly skilled and competent workforce equipped with the key skills of tomorrow.

Pears (2020) emphasizes the need for specialists in the service sector to acquire skills and knowledge on energy efficiency, which will allow them to make economically sound decisions and increase labor productivity at enterprises in the industry. Zang et al. (2022) stressed developing energy efficiency skills, professional experience, and social and behavioral competencies among employees of companies in various spheres of the economy for the construction of a smart city. Akyazi et al. (2022) claim that modern companies, regardless of the type of activity, should prepare to fulfill the requirements of sustainable development in the future, implement digital and environmental innovations in a timely manner, and comprehensively educate their employees and provide them with appropriate skills. Zinovieva et al. (2023) proved that energy specialists must be equipped with high-tech skills that increase the efficiency of decision-making regarding the use of renewable energy sources to accelerate the transition from traditional to renewable energy sources within the country's economy. Nguyen et al. (2020), Awad et al. (2024), and Castillo-Vergara et al. (2024) prove the need for self-development and life-long learning, creativity, and adaptability among employees of various professions, which should promote large-scale implementation of innovative technologies, transition to renewable energy sources, and mitigation of climate change.

The second approach focuses on educational institutions and substantiates those tools and strategies that will enable the students to efficiently build the skills of tomorrow as a component of their training or educational program. In particu-

lar, Biancardi et al. (2023) emphasize that universities should become centers responsible for shaping ecologically sustainable communities and provide graduates with knowledge and skills in energy efficiency to gradually construct national energy independence. Burazor and Salihović (2023) showed that problem-oriented training on energy efficiency and sustainable development contributes to the improvement of architectural education and enhances the graduates' competence to plan an effective professional life and overcome rapid changes in modern society. Bonnaud (2023) emphasizes that educational institutions should equip graduates of various specialties with the latest skills in economic energy consumption, which will increase the productivity of various spheres of the country's economy. D'eon and Silverman (2023) give examples of effective combinations of ecological principles and sustainable development goals to design educational programs that teach the effective use of various fuel types in everyday life and production and reduce a negative environmental impact. Tunji-Olayeni et al. (2023) discovered that imparting sustainable construction skills to construction students will become the basis for wider use of renewable energy sources, increase energy efficiency, and reduce waste in the country.

Dias-Oliveira et al. (2024) justify the importance of developing critical thinking, teamwork, and communication skills for first-year students. Nicolaou et al. (2024) and Yuan et al. (2024) prove the importance of leadership skills and digital literacy for the successful training of medical students. Jassim et al. (2024) emphasize that the development of emotional intelligence is a significant factor in training students in music disciplines. Chen and Chang (2024) determine that the basis of management education should rely on creative problem-solving skills. Tran et al. (2024) and Tan et al. (2024) identify student skills that contribute to successful learning. Panakaje et al. (2024), Vlachopoulos and Makri (2024), Kailas and Bhatt (2024), and Wahab et al. (2024) focus on identifying the employability skills of university graduates. Lacruz and Sofiate (2024) determine the effectiveness of business games for students to enjoy learning and acquire skills faster. Kart and Şimşek (2024) and Yaccob et al. (2024) proposed their own competency model for university graduates, which is structured around three components: knowledge, skills, and values, each of which is further elaborated. The goal of this model was identified as improving the quality of national higher education and ensuring compliance with international standards, which aligns with the focus of the current study.

The priority of monitoring the level of food security in the regions of Ukraine as a leading sector of the national and regional economic systems, on the balance of which the prospects for sustainable development depend, is substantiated. Uhodnikova et al. (2024) specify all groups of war consequences for Ukraine and assess the prospects for achieving sustainable development goals in the post-war period. In the context of Ukraine's national revival, Mytsyk et al. (2024) and Nesterenko et al. (2024) prove the effectiveness of STEM education in developing the skills necessary to achieve sustainable development goals. Universities should play a pivotal role in forming key skills of the future, as they should become socially responsible in training highly competitive specialists. One aspect of this responsibility should be a partnership between universities and the community in promoting the sustainable development of Ukraine's economy (Sikorska & Gerasymchuk, 2023). Comi et al. (2023) emphasize the importance of introducing innovations into the activities of universities, which will allow modernizing educational programs to train new professionals. Ma et al. (2022) emphasize the importance of restoring the professional and personal potential of the country's university teachers, which will become the basis for training specialists capable of ensuring sustainable development in the country in the post-war period.

The keen interest in determining tomorrow's key skills should convince Ukrainian practitioners to focus on those skills when implementing a personnel strategy. Such a strategy will allow businesses to win a competitive position while simultaneously achieving sustainable development goals. In turn, Ukrainian universities should be able to equip graduates with all the skills that will be in demand. Without incorporating tomorrow's skills, it would be impossible to restore the Ukrainian economy after the war.

The major objective of this study is a comprehensive assessment of competencies, which, when applied in practice, will foster achieving each sustainable

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development goal separately, accelerate the pace of technical, technological, and innovative growth in the Ukrainian economy toward Industry 4.0, and evaluate the ability of Ukrainian higher education to reproduce the key skills of tomorrow.

2. METHODS

The normative field of the current study is outlined by the current normative documents issued by the Ministry of Education and Science of Ukraine and the Department of Economic and Social Affairs Sustainable Development of the United Nations.

Based on the keywords frequent in recent research publications on the topic, the framework for developing key future skills has been identified. The skills necessary to achieve sustainable development goals were analyzed to determine five groups. Grouping and identifying the future skills showed whether Ukrainian higher education standards focus on equipping undergraduate students with these skills across various specialties. Additionally, this study analyzes the areas of research conducted at leading Ukrainian universities toward the implementation of sustainable development goals.

The following methods have been deployed to visualize, demonstrate, and assess the research information base.

A scientific abstraction method helped to specify human skills, which, if mastered by the vast majority of the country's population, will enable the country's economy to achieve each sustainable development goal.

A selective and comparative analysis assessed if individual standards of higher education for bachelor-degree programs are oriented at providing the students with key skills of tomorrow. The paper analyzes the standards of 25 specialties related to 18 fields of higher education in Ukraine. This selection was based on the criteria of the availability of an approved standard and the potential of graduates to restore the country's economy in the post-war period. The degree to which the standard is focused on providing graduates with key skills for the future was assessed by comparing the list of graduate competencies approved in the standard and the skills identified in the study aimed at sustainable development goals.

Logical generalization has formulated seven aspects that should be considered when forming the list of key future skills and justifying the five groups of key future skills.

The data visualization in the form of a word cloud was carried out using Microsoft's WordArt service. The keywords of all scientific articles served as the initial basis for using the service.

The analysis of the research areas conducted by leading Ukrainian universities in relation to the implementation of sustainable development goals was carried out using a new feature introduced by the Elsevier Data Science team in Scopus profiles. The function is based on the machine distribution of all articles in the profile over the past 10 years by keywords according to each of the 17 sustainable development goals.

3. RESULTS

3.1. The term "skills of the future"

The analysis of the research publications justifying the expediency of this research topic resulted in the cloud of keywords selected from the literature (Figure 1). This cloud visualizes the vectors that are prevailing today and outlines the key skills that will allow Ukrainians to reduce the time required to completely restore Ukraine's economy in the post-war period.

Hence, the analyzed publications most often discuss future skills in terms of sustainability, skills, Industry 4.0, energy, energy efficiency, education, productivity, and creativity, which are, correspondingly, the aspects to focus on while studying this multifaceted phenomenon. Based on the aggregated and generally accepted understanding of the abovementioned terms existing in the literature, the paper developed the following explanations of the key aspects of future skills that will underpin every stage of this analysis.

Sustainability stresses that substantiating and formulating key skills of the future should be imple-

Figure 1. Word cloud with the keywords found in the literature

mented with the sustainable development goals in view under imminent business conditions and existing global trends, which will create opportunities for their achievement for a specific business, a separate region, or the country as a whole.

Skills include formulating the key skills of tomorrow and attempting to further disseminate them in student classrooms, among the unemployed, and among the workforce at enterprises in all branches of the country's economy. This will precondition accelerated recovery and further strategic development of the country's economy.

Industry 4.0 says that when justifying the key skills of tomorrow at the national level, significant attention should be paid to those modern intellectual technologies and progressive trends that have already been implemented in production or are being intensively developed in progressive countries. Today, these technologies include artificial intelligence, the Internet of Things, robotic technology, augmented and virtual reality, Big Data, 3D and 4D printing, cloud services, integration, and digital transformation of all production processes, etc.

Energy, within the framework of sustainability and Industry 4.0, as a production resource, is the key factor in the modern innovative development across every sphere and branch of the economy without exception. In addition, a primary concern is the transition to those energy sources that will minimize the footprint that society's vital activities leave on the environment and prevent further climate changes in the world (sun and wind energy, geothermal energy and biomass energy, hydropower, ocean energy, etc.).

Education claims that disseminating the key skills of tomorrow among the population should rely on the high quality of formal, informal, and non-formal education in the regions and across the country, as well as university educational programs aiming to provide graduates with these skills.

Energy efficiency and energy-saving skills within the sustainability concept should become basic skills for every member of society regardless of age, level of education, or acquired profession. These skills should be inoculated in childhood, and, while maturing, the individual should consolidate and reinforce them with specific theoretical knowledge.

With the current technical and technological development of production processes, it is practically impossible to achieve satisfactory productivity without employees equipped with skills such as creativity and innovation, and therefore, sufficient attention should be paid to their development at all levels in the country.

Each of the seven aspects mentioned above should be studied carefully when substantiating the key skills of tomorrow to be promoted with-

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in Ukrainian society. Disseminating these skills among the workforce will reduce the time needed for Ukraine's economy to overcome the crisis and ensure its future resilience.

3.2. Future skills for the implementation of sustainable development goals

Skills have been an increasingly important area for business entities in Ukraine over the past decade. Thus, Ukrainian entrepreneurs have long agreed that soft skills should be prioritized when selecting applicants for vacant jobs (Zakharova et al., 2022). Indeed, a motivated person can master the necessary professional skills in a few months, while social skills are either inborn or absent and, consequently, exceedingly difficult to acquire through training. This category embraces communication skills, teamwork, leadership, psychological stability, flexibility, conflict resolution skills, ethics, honesty, creativity, motivation and self-motivation, and time management skills. However, the aforementioned skills are useful for an individual in the first place, as they expand the individual's circle of communication, boost personal career levels and income, and secure the feeling of being a valuable member of society. As a result, the person's mental health improves, and stress resilience increases, thus preventing professional burnout and psychological injuries. Consequently, employees equipped with soft skills will be more productive and will fetch higher profits for the company.

The spread of both soft and hard skills among the country's population will have a limited positive effect. However, it will not ensure a powerful technological breakthrough for the country's economy able to reach a new technical and technological level of development. Therefore, soft skills, along with hard skills, serve as the foundation on top of which another type of skills will be mounted, and which will ensure the expected breakthrough. Further, these skills will be defined as 'the key skills of tomorrow.'

The Resolution "Transforming our world: The 2030 Agenda for Sustainable Development" (United Nations, 2015) announced a new plan for building a strategy for global sustainable development. This strategy includes seventeen goals, and the countries will achieve sustainable development by implementing each goal. Therefore, it would be expedient to identify those skills that will accelerate the implementation of the sustainable development goals. The text of the Resolution states that the whole complex of skills acquired through various types of training by young people and the population as a whole should provide them with opportunities to be fully involved in social life, find decent work, participate in entrepreneurial activities, work productively, receive satisfaction from the work, etc. Skills for sustainable development and sustainable living should also be seen as important, in particular, skills for guaranteeing human rights, gender equality, promotion of peace and non-violence, cultural diversity values, etc. Consequently, efforts should be focused at the governmental and regional levels to ensure that these skills are in demand on the labor market.

The results demonstrate how each sustainable development goal can be applied in the Ukrainian context (Ministry of Economic Development and Trade of Ukraine, 2018). Here, those skills are specified that the vast majority of the country's population should acquire to achieve the specified sustainable development goals (Table 1). In this regard, the skills substantiated within the framework of the World Economic Forum (2020) are considered as those that should become globally relevant by 2025.

Having defined the skills of tomorrow based on their alignment with the declared sustainable development goals and Industry 4.0 requirements, they have been referred to one of the five groups according to the nature of the skill.

Personal and communication skills include communication, ability to work in a team, leadership, psychological stability, vitality, flexibility, conflict resolution skills, ethics, honesty, motivation and self-motivation, time management skills, persistence, and goal-achieving.

Knowledge and organization skills comprise digital literacy, critical thinking, initiative, the ability to actively learn throughout life, foreign language mastery, the desire to obtain a decent job,

the ability to get satisfaction from work, the ability for entrepreneurial activity, productive work, social inclusion, full participation in society, and the ability to adopt a comprehensive approach to problem-solving.

Intellectual and innovative skills consist of abstract thinking, creativity, and innovation; skills for scientific and research work; the ability to develop, evaluate, and use the latest information and digital technologies; skills in data analysis, programming, and the use of information and communication technologies.

Resource conservation and resource efficiency skills include rational and economical use of water in everyday life and in production, energy efficiency, application of the latest technologies of resource conservation and resource efficiency, and transition to innovative technologies of economic consumption and production.

Tolerance and quality of life skills comprise observance of human rights, gender equality, promotion of peace and non-violence, refraining from all types of inequality, understanding values of cultural diversity, the cult of a healthy lifestyle,

Table 1. Key skills needed to achieve sustainable development goals

Goals	Skills needed to achieve the goal
1	Each individual contributes to fighting poverty by providing the family with a decent income. If the majority of the workforce is equipped with entrepreneurial abilities and skills, creating new jobs will expand the positive effect and increase the level and quality of life
2	The most important individual skills aimed at achieving this goal for those involved in domestic agricultural production are productive work and the ability to quickly master innovative technologies that would contribute to the preservation of ecosystems and improve the quality of lands and soils
3	To achieve this goal, the cult of a healthy lifestyle should be introduced in the country. The individuals will benefit from skills such as vitality, stress resistance, and psychological flexibility. Representatives of medical specialties ought to be trained to think innovatively, analytically, and critically, develop and apply cutting-edge methods of treatment, diagnosis, and disease prevention
4	The quality of education at all levels should be assessed based on those key skills of tomorrow that will allow the country to fully achieve sustainable development goals. Along with the aforementioned skills, active lifelong learning and analytical thinking will become important
5	At the personal level, approaching this goal means equal opportunities to develop skills such as leadership, communication skills, ability to work in a team, psychological stability, creativity, self-motivation, and the desire to achieve the set goal for representatives of all genders
6	At the personal level, realizing this goal will be facilitated by skills such as a conscious desire for rational and economical use of water in everyday life and production. In professional activity, the skills of innovative management of water supply, water use, and drainage are gaining importance
7	At the personal level, the availability of energy efficiency and rational use of energy resources, their daily use in everyday life and professional activities will contribute to the realization of this goal
8	Fulfilling this goal at the individual level will require disseminating highly productive, creative, and innovative work skills. Subsequently, the management of enterprises should create favorable conditions for the realization of the human capital potential
9	At the individual level, this goal requires stimulating skill acquisition for highly productive, creative, and innovative work, conducting scientific research, and using the latest tools of the digital economy in order to enhance work efficiency
10	In the post-war period, Ukraine will face the challenge of providing decent work to all citizens who have suffered various kinds of injuries during the war. Therefore, governmental programs offering key future skills should be planned and launched, involve persons with disabilities in active life
11	At the individual level, it is possible to achieve this goal within a certain territory by strengthening the residents' communication skills and active participation in community life, leadership, and social inclusion in community affairs
12	At the individual level, the country can achieve this goal by developing environmentally friendly skills, recycling waste, and transitioning to innovative technologies in economic consumption and production
13	At the individual level, citizens can contribute to this goal by acquiring and implementing skills of living green, sorting solid household waste, saving energy in everyday life and at the workplace, rational use of personal means of transportation
14	Fulfillment of this goal at the individual level will be ensured by the skills of conscious human prevention of any pollution of the marine environment, the ability to create and use modern pollution-preventing technologies
15	At the individual level, this goal requires skills in developing and using innovative technologies to restore degraded lands and soils and preserve natural reserves
16	In order to realize this sustainable development goal, it is necessary to cultivate skills for ensuring human rights and promoting peace and non-violence at the individual level. For Ukraine, today and in the post-war period, demining skills will be crucially relevant
17	At the individual level, a person can contribute to the realization of this goal through the skills of initiative and analytical thinking, supported by fluency in any international language, and will apply these skills to promote the home country as open to partnership and constructive cooperation for the sake of peace and sustainable development

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constructive healthy habits and caring for other people's health, caring for the environment, and sorting solid household waste.

The country will promote the successful realization of both sustainable development goals and principles of Industry 4.0 to maximize the dissemination and incorporation of the future skills listed above. This is especially relevant for Ukraine, whose economy is in crisis, having suffered great losses and damages due to the Russian invasion.

3.3. Focus of Ukrainian higher education standards on building future skills

In order to assess if HEIs in Ukraine are focused on providing students with key future skills, the contents of the current higher education standards for bachelor's degree programs must be analyzed in terms of graduates' competencies (Ministry of Education and Science of Ukraine, n.d.). Table 2 summarizes the coverage of the current higher education standards for the five groups of key future skills. The bachelor's degree was chosen as the object for this study since this educational level has a sufficient duration (four years), and during this period, students intensively accumulate theoretical knowledge and practical skills which they will apply in various spheres of their future professional activity (Zakharova, 2019). In addition, in the period of life corresponding to the age of 17-22 years, a person is able to consciously perceive new information, which is quickly consolidated, appropriated, and builds up specific life-long skills. The specialties have been selected for evaluation based on two criteria. The first requirement was the availability of an approved governmental standard of higher education at the appropriate level, and the second requirement was the standard's potential to maximally cover various aspects of a person's life through various professions.

The results indicate that current bachelor's degree programs in Ukraine offer, at best, a superficial coverage of the key future skills. Investigation of the first group of skills, i.e., personal and communication skills, revealed that for only five out of twenty-five specialties, the educational standard requires the provision of time management skills, ethics, and achievement of the set goal in addition to the development of teamwork competencies. Other skills belonging to this group were not reflected in the analyzed standards.

Table 2. Summary of the objectives formulated by Ukrainian higher education standards for bachelor educational level related to the key skills of tomorrow

Source: Elaborated based on Ministry of Education and Science of Ukraine (n.d.).

Specialty	Key skills of the future				
	personal and communication	knowledge and organization	intellectual and innovative	resource conservation and resource efficiency	tolerance and quality of life
015 Professional Education	+	++	++		++
022 Design	+	+	+		++
035 Philology	++	+	+		++
051 Economy	+	+	+		++
053 Psychology	++	++	+		++
061 Journalism	+	+	+		++
076 Entrepreneurship, Trade and Exchange	+	++	+		++
101 Ecology	+	+	+		++
103 Earth Sciences	+	+	+		++
105 Applied Physics and Nanomaterials	+	+	+		++
122 Computer Science	+	+	+++		++
133 Industrial Engineering	++	+	++		++
136 Metallurgy	++	+	+	+	++
145 Hydropower	+	+	+		++
151 Automation and Computer-Integrated Technologies	+	+	++		++

Table 2 (cont.). Summary of the objectives formulated by Ukrainian higher education standards for bachelor educational level related to the key skills of tomorrow

Specialty	Key skills of the future				
	personal and communication	knowledge and organization	intellectual and innovative	resource conservation and resource efficiency	tolerance and quality of life
163 Biomedical engineering	+	+	++		++
171 Electronics	+	+	++		++
181 Food Technology	+	+	++	+	++
183 Environmental Protection Technology	+	+	+		+++
184 Mining	+	+	+		++
192 Construction and Civil Engineering	+	+	+	+	++
205 Forestry	+	+	+		++
208 Agricultural Engineering	+	++	+	+	++
224 Medical Diagnostics and Treatment Technology	+	+	++	+	++
274 Automobile Transport	++	+	+		++

Note: + indicates the presence of future skills by group in the standards.

Analysis of knowledge and organization skills showed that standards for only four specialties prescribe the provision of critical thinking competencies, understanding of the subject area, professional activity, and the ability to run a business and develop the ability to acquire up-to-date knowledge. Other skills belonging to this group were omitted.

Standards for only eight specialties include teaching intellectual and innovative skills into the requirements of educational programs. In addition to the ability to use information and communication technologies, HEIs should teach competencies of abstract thinking, creativity, generation of innovative ideas, and research skills. This group of skills is best represented in by computer sciences. Other skills belonging to this group are not represented in the standards.

Resource conservation and resource efficiency skills, described, for example, as resource conservation within professional competencies, are sporadically present in five educational standards. Other skills of this group are absent.

Surprisingly, tolerance and quality of life skills were most extensively represented in the educational standards. All the analyzed standards contain general competencies regarding understanding the values of civil society, a healthy lifestyle, cultural diversity, and the ability to communicate in a foreign language. To the greatest extent, this group of skills is revealed within the standard for the technologies of environmental protection specialty, which emphasizes the need to consolidate the skills of waste management and environmental protection. No mention of other skills of this group in the standards could be detected.

3.4. Research areas at Ukrainian universities to achieve sustainable development goals

The study sought to focus on another important aspect, namely, to determine if Ukrainian universities are prepared to transfer the skills of the future to the next generations of the workforce. The task of assessing this aspect is complicated due to the multifaceted nature of the criterion. Nevertheless, a measurable aspect is the progress of the scientific research conducted by university teaching staff, which in itself is an external manifestation of this ability. A new feature introduced by Elsevier Data Science in 2024 assists in tracking the contribution to achieving the sustainable development goals through the number of papers published in Scopus over the last 10 years per university broken down by each goal. This feature was utilized to analyze the focus of scientific research published in Scopus by Ukrainian universities that ranked top five among Ukrainian universities in 2024 (OsvitaUA, 2024) (Figure 2).

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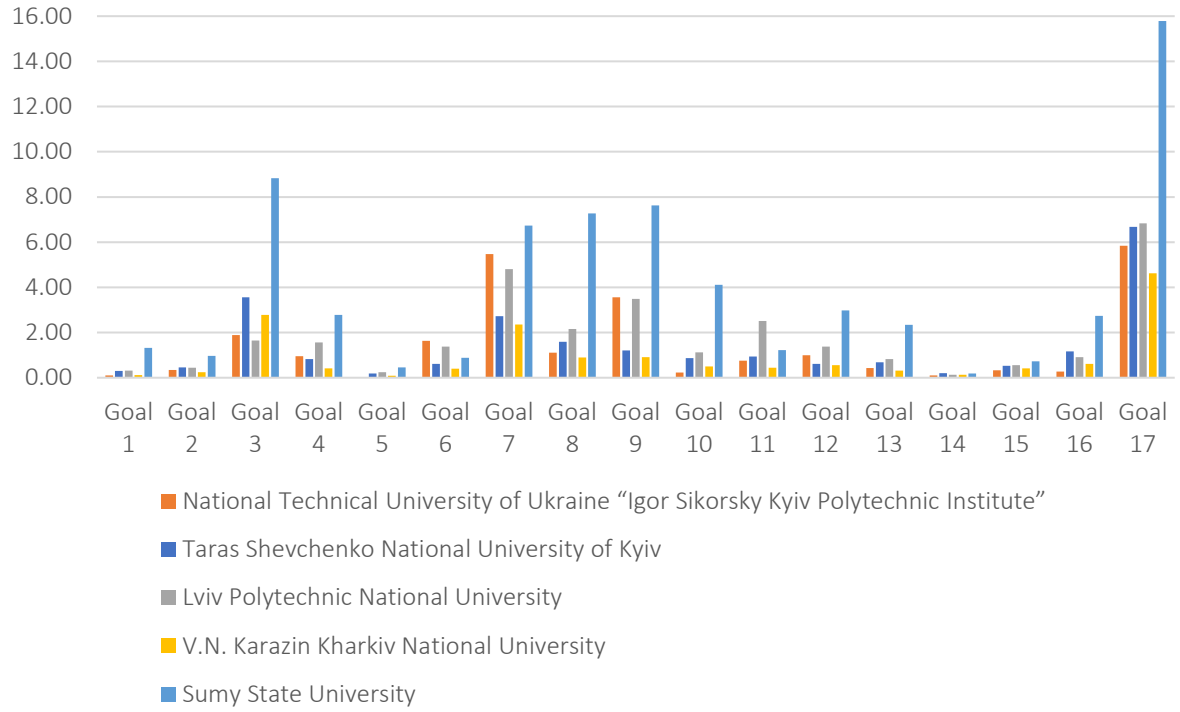

Figure 2. Distribution of scientific papers indexed in Scopus among leading Ukrainian universities according to sustainable development goals, % published papers

The fact that all five universities have showcased research that contributes to the implementation of each of the seventeen sustainable development goals is, beyond any doubt, excellent. However, a less positive trend is that Ukrainian researchers from the aforementioned leading universities are less concerned with the implementation of goals 1-2, 4-6, and 10-16 than the other five goals, which may affect transferring skills that should become relevant in the near future to the students. Therefore, expanding the research fields within the framework of sustainable development goals conducted by Ukrainian universities should underpin more effective development of key future skills in graduates.

4. DISCUSSION

The analysis has identified groups of key future skills across various disciplines that undergraduate students must acquire to remain competitive on the labor market and contribute effectively to achieving sustainable development goals within the national economy. In this context, this paper aligns closely with the findings by Uzorka et al. (2024). Nonetheless, it would be equally beneficial to analyze the skills currently in demand in the labor market and those anticipated to be required of young professionals in the near future (Krasna, 2024).

It is also essential to explore in greater detail the key skills that university educators must possess to ensure an effective process of fostering essential future skills in young people (Canal et al., 2024). Educators need to conduct relevant scientific research and engage in continuous professional development to cultivate these skills.

It is also necessary to consider the socio-cultural risks that affect the development of key future competencies in young people, as explored by Krasnoshchok et al. (2024). Additionally, it is essential to examine the potential of the educational environment in fostering key future skills among young people and mitigating these risks.

In recent years, the Ukrainian educational system has been gradually moving toward aligning basic education management documents with international standards. As part of these processes, the list of fields of knowledge and specialties in which higher education applicants are

being trained is being currently transformed. After the final approval, six months will be allowed to harmonize all derivative documents, including education standards. This period is expected to be most favorable for introducing the key skills of the future into educational programs. Providing students of all specialties with skills for creative and innovative work, energy saving and energy efficiency, caring for the environment, sorting solid household waste, etc., will promote the implementation of sustainable development goals, smart specialization, smart economy, and digital economy. In addition, inoculation of these skills with Ukrainian youth will reduce the time they would otherwise need to adapt to new living conditions, which, due to the rapid development of artificial intelligence and the latest technologies, will soon alter the global professional landscape.

Future investigations should focus on fostering collaboration between educational institutions and representatives of the business sector to cultivate highly competitive professionals.

CONCLUSION

This study set out to define and assess future skills the development of which among graduates of Ukrainian universities will contribute to sustainable development and accelerate the pace of technical, technological, and innovative growth of the Ukrainian economy. The results demonstrate that Ukrainian higher education standards require strengthening, detailing, and more active implementation of the key skills of tomorrow to ensure achieving sustainable development goals and accelerated post-war recovery.

The full-scale war has been continuing for almost three years, and every Ukrainian sincerely believes that justice will prevail and Ukraine will soon win the long-awaited victory. In the post-war period, the country will face the complex task of restoring the economy, rebuilding cities and villages, and renovating infrastructure. There is a general trust in the availability of the financial resources required to restore the economy. However, what approaches will underlie the recovery of the post-war economy? These future approaches should be found and determined today, and they should not be viewed from the populist perspective; they should rather be formulated through specific changes and reforms that higher education must introduce. The first measure that should be taken is extending the range of skills that Ukrainians should acquire, regardless of age, mainly through supplementing the existing skills with workplace-based key skills of tomorrow, which should be disseminated through the education system.

AUTHOR CONTRIBUTIONS

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