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Research

Sustainable development awareness and integration in higher education: a comparative analysis of universities in Central Asia, South Caucasus and the EU

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Abstract
Education for sustainable development in universities is shaping the agenda in this area, demanding continuous improvement in quality. There is a trend towards integrating sustainability issues and the implementation of sustainable development goals into higher education. Universities responsible for educating SD professionals must teach knowledge and develop skills in line with the SDGs. However, there is insufficient attention to this in educational programs; more often it is implemented through disparate initiatives. The article presents research conducted in universities in the countries of Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan), South Caucasus (Georgia, Armenia) and the European Union (Italy, Bulgaria, Poland). The awareness of students and teachers about the SDGs, the problems of implementing SD were assessed, and ways to solve these problems were analyzed. Countries were divided into clusters for comparative analysis. The results show that students generally have limited knowledge about the global sustainable development goals, while teachers have a higher level of awareness. The article examines the contribution of education to raising students' awareness in the countries studied and their attitudes towards integrating sustainability into the curriculum. The questionnaire showed that the educational intervention significantly influences students' intention to engage in sustainability. Overall, students demonstrate positive attitudes towards incorporating sustainability issues into their education. The results of a study conducted in higher education institutions in Central Asia, South Caucasus and the European Union showed that students are generally unaware of the sustainable development goals, their information received through the Internet, media and university studies is insignificant, while teachers are better informed. Students and teachers expressed the greatest concern about environmental, social and economic problems. At the same time, students of engineering, technical and medical fields are more informed about the SDGs compared to pedagogical and socio-humanitarian fields. To increase awareness, universities are encouraged to integrate sustainability education into various disciplines, conduct seminars, round tables, promote student participation in projects and research, and promote international cooperation and knowledge sharing.

Keywords Education for sustainable development · Sustainable development goals · Awareness of the SDGs · SDG education in universities · Central Asian countries · South Caucasus countries · EU countries · Assessment of learning

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1 Introduction

Identifying experiential learning as the theoretical basis of reasoning that led to the indication of the paradigms necessary to acquire skills [1], and consequently, promoting specific skills aimed at achieving the Sustainable Development Goals, helps graduates to better understand contemporary challenges and to actively apply their knowledge in various professional fields, contributing to sustainable development at a local and global level.

Developing competencies related to the Sustainable Development Goals (SDGs) is becoming a priority for higher education for a number of reasons. First, sustainable development represents a key challenge for humanity in the face of climate change, depletion of natural resources, threats to biodiversity and social justice [2–5]. In these conditions, higher education must prepare specialists capable of making effective decisions in these areas.

Global communities are taking significant steps toward achieving the SDGs, as demonstrated by initiatives like the Paris Climate Agreement and the 2030 Agenda for Sustainable Development. These key documents emphasize the critical role of incorporating sustainable development into educational curricula. As a result, there is a growing demand from employers for professionals who possess knowledge and skills related to sustainable development. This trend is driving the need for highly skilled graduates capable of integrating environmental, social, and economic considerations into their professional work [6].

Civil society and younger generations are increasingly demanding that universities take an active role in educating students about sustainable development. In response to these demands, many higher education institutions in developed countries are integrating sustainable development into their strategic plans. They develop relevant educational programs and courses, organize scientific research and practical projects. Developing competencies related to the SDGs helps graduates better understand contemporary challenges and actively apply their knowledge in various professional fields, contributing to sustainable development at the local and global levels [7–9].

The problem of the study is the lack of awareness of students and teachers of universities in Central Asia, the South Caucasus and the European Union about the SDGs. Despite the growing importance of sustainable development in the global agenda, students' knowledge of the SDGs remains limited, which reduces their ability to contribute to solving environmental, social and economic problems. The lack of systematic integration of sustainable development topics into university curricula further exacerbates this problem.

The purpose of this study is to assess the level of awareness of students and teachers of universities in Central Asia, the South Caucasus and the European Union about the Sustainable Development Goals, as well as to analyze the integration of sustainable development concepts into educational programs. Based on the data obtained, scientifically based recommendations were developed for the introduction of sustainable development modules into university curricula to increase students' awareness and readiness to solve pressing global problems.

2 Literature review

Universities play a key role in preparing future leaders who can make significant contributions to transforming society towards sustainable development. They achieve this in two main ways: (a) creating new knowledge in the field of sustainable development and (b) transferring this knowledge to society, preparing students for their future roles in it [10, 11]. Education based on the principles and technologies of sustainable development can be a key factor in achieving the SDGs, as it increases awareness, appreciation and practical application of sustainable solutions in both everyday life and professional activities [12].

Therefore, it is necessary to motivate and inspire teachers and students in the field of sustainable development, identify key areas of activity, establish competence areas for solutions and integrate the concept of sustainable development into university curricula [13, 14]. However, there is currently no consensus on a definition or list of desired skills, competencies or learning outcomes for sustainable development. Additionally, there is little guidance on what courses and subjects should be included and how to do so [15], although it should be remembered as the case of the enactment of law 92/2019 in Italy (which introduced teaching and civic education in all scholastic levels, understood as a discipline of a transversal nature, within whose conceptual cores environmental sustainability has been expressly indicated, with specific references to the 2030 Agenda) represents an interesting exception [16].

The 17 Sustainable Development Goals (SDGs) and their 169 targets aim to realize the human rights of all people, achieve gender equality, reduce poverty, and ensure a better quality of life for everyone. To achieve sustainable development, it is essential to harmonize three core elements: economic growth, social inclusion, and environmental protection. These elements are interconnected and vital for the well-being of individuals and societies. A healthy individual contributes to the economy and is an asset to any nation, which is why human capital is often considered a nation's most valuable resource. Despite living in an era of advanced science and medicine, millions of people still die each year from preventable diseases, untreated drug and alcohol abuse, avoidable birth defects, poor air and water quality, substandard living conditions, and preventable traffic and industrial accidents. Every person has the right to well-being, a good quality of life, equality, and access to medical care. We must ensure that every individual, whether child or adult, receives the resources they need to live a long and healthy life.

The Sustainable Development Goals are not legally binding, so all responsible global citizens must act locally, advocate for change and hold decision makers accountable for their commitments. Education and awareness raising have a major responsibility. Every generation, no matter where they are, must be informed and educated to understand their role and unite in this fight. The most important tool is the effective sharing of information, research and knowledge among citizens.

The values of the SDGs are significant. The various SDG goals provide a platform for mitigation and rapid response. Climate change is a cross-cutting issue that should be considered in all sectors and human activities. Sustainability is not a new concept; we could have learned much from our past and our ancestors. The importance of sustainability is greater than ever. It represents a responsible and strategic response to human development, ensuring the future of the Earth. The Sustainable Development Goals are important opportunities to improve the quality of life for all human beings and our planet. How we achieve them should be a topic of strategic discussion.

In addition to international conventions, national-level policies and strategies that address the issues targeted in the 2030 Agenda, the time-bound and universal nature of the SDGs results in greater mobilization of the global community, strengthens collaboration and networking among stakeholders across sectors, countries, and regions, and promotes innovation and the sharing of expertise and best practices.

Another critical argument for the SDGs is that they support a long-term strategic approach to addressing global challenges. These challenges are not unique to certain countries; they are shared by many and require joint, focused interdisciplinary actions that mobilize everyone. Most governmental programs and action plans have a relatively short lifespan, and their sustainability is often questioned due to changes in government and political agendas at all levels. In this regard, the SDGs set long-term targets for the next 15 years, minimizing the risk of non-implementation. Importantly, the SDGs, agreed upon by 193 countries, promote sustainability of actions and reinforce the commitment of states, regardless of changes in the national political context.

The SDGs focus on all people and their full inclusion. Open, transparent, and participatory processes will allow all stakeholders to voice the needs and interests of the people they represent, enabling better planning and more inclusive initiatives. All stakeholders, including governments, universities, international organizations, the business and industry sectors, civil society organizations, and individuals, must contribute.

The SDGs place a strong emphasis on collaboration at all levels—globally, nationally, regionally, and locally—with everyone expected to contribute to achieving the targets over the next 15 years. The most secure way to achieve sustainable progress is through changes in education at all levels, in all parts of the world. Inclusive and focused education, combined with practical examples and innovation, will cultivate generations of educated and connected individuals who are responsible and skilled in ensuring sustainable development. The SDGs should be integrated into all curricula across all sectors and fields of human activity. Interdisciplinary and comprehensive actions will unite people toward a common goal: a better quality of life for all.

Research by Gordon and Soulemans [17, 18] and others emphasize the importance and necessity of integrating the concept of sustainable development into the curricula of all disciplines. They point out that incorporating sustainability into the classroom helps students understand how their actions and decisions impact the environment and society.

Despite the clear need to integrate sustainability into curricula, according to a survey of higher education students around the world, previous research shows that sustainable development is not yet mainstreamed into educational curricula [19]. However, to maximize the impact of various education for sustainable development initiatives, it is critical to understand students' current beliefs about sustainable development and their expectations regarding the integration of the subject into the curriculum [20–22].

Contributing to the SDGs provides a unique opportunity to use an interdisciplinary approach to address many of humanity's biggest challenges and can help institutions in many creative and impactful ways. The SDGs are generating

increased demand for education related to sustainable development. Moreover, they are inclusive and diverse enough to be integrated into undergraduate, graduate and research programs, including classroom activities, lecture materials, projects, assignments and study trips [23, 24].

For this reason, universities should review and update their curricula to ensure they are aligned with sustainability principles in the courses they offer. In addition, the SDGs provide a comprehensive and widely accepted guide to creating a responsible university that provides solutions-oriented approaches to global problems [25].

To further achieve seamless engagement with the SDGs, universities must acquire new competencies, as global competencies such as critical and creative thinking are too general to cope with the challenges associated with sustainable development.

These competencies address sustainability issues and promote the development of the skills and attitudes needed to effectively solve problems and improve performance.

Institutions must offer the appropriate set of skills, knowledge, attitudes and values needed to prepare today's students who will become tomorrow's leaders to solve complex sustainability problems and achieve success in a sustainable future.

3 Methods

The purpose of this study is to analyze the awareness of students and teachers regarding the implementation of the SDGs for the subsequent development of scientifically based recommendations for the implementation of modules on sustainable development in educational programs of universities.

Research methodology. To achieve this goal, a study was conducted that used the methodology of surveying respondents through formal interviews at their places of study and work. The total sample size was 1203 students and 272 teachers. The sample was representative according to the following parameters: gender, age, education, place of study, work and residence.

The observed disproportion in the number of respondents from different regions can be explained by several factors related to the study design and data collection methodology. While the initial plan aimed for approximately 80 student and 20 teacher respondents from each participating university, the actual sample distribution was influenced by the number of universities involved in each region. In Central Asia, 12 universities participated in the study: 7 from Kazakhstan, 3 from Tajikistan, and 2 from Kyrgyzstan. In contrast, only 7 universities from South Caucasus and the European Union (Georgia, Armenia, Italy, Bulgaria, and Poland) were included.

Moreover, the data collection was conducted via a voluntary online survey using Google Forms, which introduced variability in response rates across regions. In Central Asia, student respondents showed a higher level of engagement, contributing to a larger number of returned questionnaires. However, teacher respondents from the European Union and South Caucasus displayed greater interest in participating compared to their Central Asian counterparts.

These differences in response rates reflect not only the methodological aspects of the survey but also potential cultural and organizational factors that could have influenced the willingness to participate. The final data analysis accounted for these variations to mitigate the impact of the disproportion on the study's conclusions. Nevertheless, the unequal participation levels should be considered when interpreting the results, as they may affect the generalizability of the findings across the broader regional contexts.

Geography of the study. The study was conducted in educational institutions of the Central Asian republics (Kazakhstan, Tajikistan, Kyrgyzstan and Uzbekistan), the countries of South Caucasus (Georgia and Armenia), as well as the countries of the European Union (Italy, Bulgaria and Poland). Period of the field phase of the study: from October 2023 to January 2024.

Object of study: Students and teachers of engineering, technical, medical, pedagogical and socio-humanitarian fields.

Subject of study:

1. Awareness of students and teachers about the SDGs.
2. Perception and understanding of the SDGs.
3. Evaluation of teachers' implementation of modules on sustainable development in the educational process.

Research objectives:

1. Determining the level of awareness of students and teachers about the SDGs.

2. Assessing perceptions and understanding of the SDGs.
3. Evaluation of teachers' implementation of modules on sustainable development in the educational process.

The research instrument was a validated questionnaire previously used in similar studies to assess awareness of the SDGs. The questionnaire included 22 questions for students and 19 for teachers, covering various aspects of perception and understanding of the SDGs.

The data were processed using IBM SPSS Statistics 27.

4 Results and discussion

As noted in the methodology, students were given questionnaires, and the results of the questionnaire are analyzed in this section.

Answering the question: «Do you know about the global Sustainable Development Goals, adopted and signed by 193 world leaders at the historic UN summit in September 2015?», 41% of students surveyed from the Central Asian republics responded that they «don't know» 75% of respondent's students from South Caucasus countries responded that they «don't know»; 45% of the surveyed students from the countries of the European Union responded that they «don't know» (Table 1).

The most knowledgeable students among the countries surveyed were from the Central Asian republics, with 59% of them being aware of the global goals related to sustainable development. In comparison, 55% of students from the European Union were familiar with these goals.

The study reveals that over half of the students in both the South Caucasus and European Union are unaware of the timeline and number of the Sustainable Development Goals (SDGs). When asked, "Do you know the time period for the implementation of the Sustainable Development Goals?" 79% of respondents from the South Caucasus and 54% from the European Union indicated that they "do not know." In contrast, 56% of students from the Central Asian republics answered this question positively.

A significant majority of students in the South Caucasus and about half in the European Union were unable to identify the number of SDGs. In response to the question, "Do you know the number of Sustainable Development Goals and can you name one?" 80% of students from the South Caucasus and 51% from the European Union responded with "do not know."

The majority of students from universities in the Central Asian and South Caucasus regions identified social media and the Internet as their primary sources of information about the SDGs. Unfortunately, students from these regions are less exposed to this information through their formal education. When asked, "From what sources did you learn about the Sustainable Development Goals?" 33% of students in Central Asia and 24% in the South Caucasus cited social media and the Internet, while only 15.5% and 12%, respectively, mentioned they received this information during their school or university education.

In contrast, twice as many students from the European Union (36%) reported gaining knowledge about the SDGs through their formal education compared to their peers in Central Asia and the South Caucasus.

Most students are unaware of the organizations involved in sustainable development in their regions. Specifically, 69% of students from Central Asia, 78% from the South Caucasus, and 67% from the European Union responded negatively to the question, "Are you aware of structures involved in sustainable development in your region?".

Among the students who answered positively regarding awareness of such organizations, many pointed to UN divisions and regional centers for sustainable development. In Central Asia, students also mentioned the youth organization Enactus and state political organizations.

Most students understand sustainable development as a process of coordinated change in which natural resource exploitation, investment direction, scientific and technological advancement, personal development, and institutional adjustments are aligned to enhance the capacity to meet human needs. This perspective is shared by more than 60% of students across the surveyed universities in the studied regions, who agreed that this definition best reflects the core concept of "sustainable development."

It is also encouraging to see that the majority of university students surveyed place importance on considering future generations. In response to the question, "Do you think we should consider future generations when consuming natural resources?" 82% of students from Central Asia, 89% from the South Caucasus, and 70% from the European Union agreed.

Table 1 Summary table of student's responses by cluster to questions

Question	Answer options	Cluster 1—Central Asia (%)	Cluster 2—South Caucasus (%)	Cluster 3—the EU (%)
Did you know about the SDGs adopted in September 2015	Yes	59	25	55
	No	41	75	45
Do you know the SDG implementation period?	Yes	56	21	46
	No	47	79	54
Do you know the number of SDGs	Yes	59	20	49
	No	41	80	51
Where did you learn about the SDGs from?	From the Internet	33	24	23
	From TV, newspapers	50	4	7
	While studying at the university	15	15	36
	At seminars, courses, conferences	50	8	6
	Other	40	6	6
	Don't know	37	44	22
Do you know local structures involved in sustainable development?	Yes	31	22	33
	No	69	78	67
Do you think that when consuming natural resources, we should think about future generations?	Completely disagree	3	7	10
	Disagree	3	1	3
	In the middle	14	9	17
	Agree	36	41	30
	I completely agree	44	42	40

Among the 17 Sustainable Development Goals (SDGs), Central Asian students showed the greatest interest in poverty eradication (Goal 1), good health and well-being (Goal 3), quality education (Goal 4), clean water and sanitation (Goal 6), decent work and economic growth (Goal 8), and peace, justice, and strong institutions (Goal 16).

In the South Caucasus, students prioritized goals such as poverty eradication (Goal 1), ending hunger (Goal 2), good health and well-being (Goal 3), quality education (Goal 4), clean water and sanitation (Goal 6), and peace, justice, and effective institutions (Goal 16).

Similarly, students from the European Union were most concerned with ending poverty (Goal 1), good health and well-being (Goal 3), quality education (Goal 4), clean water and sanitation (Goal 6), decent work and economic growth (Goal 8), and peace, justice, and effective institutions (Goal 16) (Fig. 1a–c).

These findings indicate that issues related to poverty reduction, health and well-being, quality education, access to clean water, sanitation, and institutional integrity are shared concerns among university students from the different regions in this study.

Students from Georgia and Armenia expressed particular concern about hunger eradication, while students from Central Asia and the European Union were more focused on securing decent work and opportunities for economic growth.

When asked to assess changes over the past 2 years in the SDGs they found most significant, most students from Central Asia reported little to no progress, with over half indicating stagnation in the goals that mattered to them.

However, it's worth noting that 33% of students in the Central Asian republics observed positive improvements in the field of quality education over the last 2 years. At the same time, 25% of respondents noted a decline in access to clean water and sanitation.

Assessing changes over the past 2 years in goals that are significant to them, more than a third of students from Georgia and Armenia note that the country has not progressed in achieving these goals, their level has remained the same.

We would like to note an interesting contradiction revealed during the study in these regions. On the one hand, a portion of Georgian and Armenian students surveyed believe that their countries have made progress in achieving good health, well-being (31%), quality education (38%), clean water and sanitation (25%). On the other hand, some students expressed concern about the deterioration of the situation in matters of poverty eradication (33%) and other important goals.

Let us make a cautious assumption that this contradiction is explained by the absence of a middle class in these countries; there is either no middle stratum of the population at all, or it is small in number. That is, in these regions there is a certain gap between the wealthy population and the poor. This is indirectly confirmed by the skepticism expressed by more than a third of respondents (46%) regarding the activities of legal and judicial institutions.

Assessing the changes over the past 2 years in terms of goals that are significant to them, the opinions of students in the countries of Italy, Bulgaria and Poland are divided. They note positive dynamics associated with the possibility of quality education (42%), access to clean water and sanitation (64%). But they are seriously concerned about issues related to maintaining peace and stability (46%), worsening the situation in eliminating poverty (45%), as well as the possibility of obtaining decent work and economic growth (40%).

We found in the course of the study that students from the South Caucasus countries and the European Union expressed the greatest concern regarding the preservation of peace and stability in society.

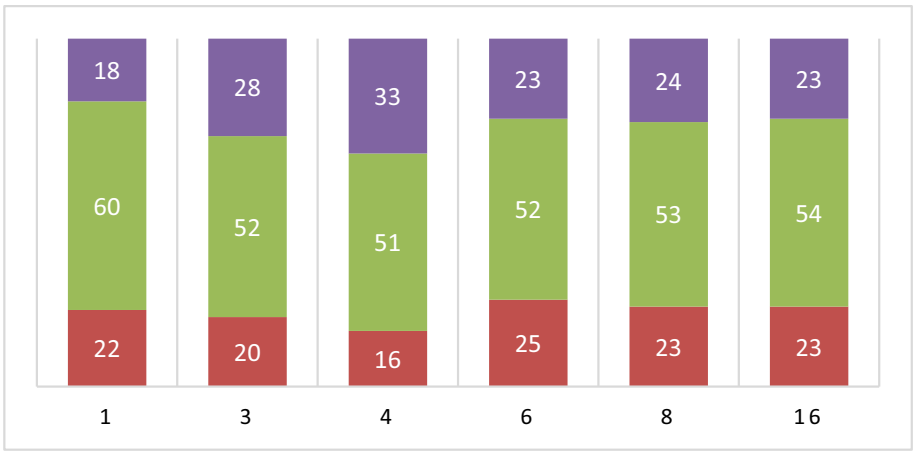
The concern of the younger generation of these regions about their future is understandable: Georgia is still recovering from the armed conflict with Russia in 2008, Armenia is on its way out of the CSTO, European countries are experiencing a deep migration crisis, the economic consequences of Covid and the latest military conflicts.

In general, students from the Central Asian republics and South Caucasus countries are more optimistic about the impact of their lifestyle on achieving the SDGs than their peers from Italy, Bulgaria and Poland; more than 40% of respondents agreed that their lifestyle has an impact on the development of the SDGs.

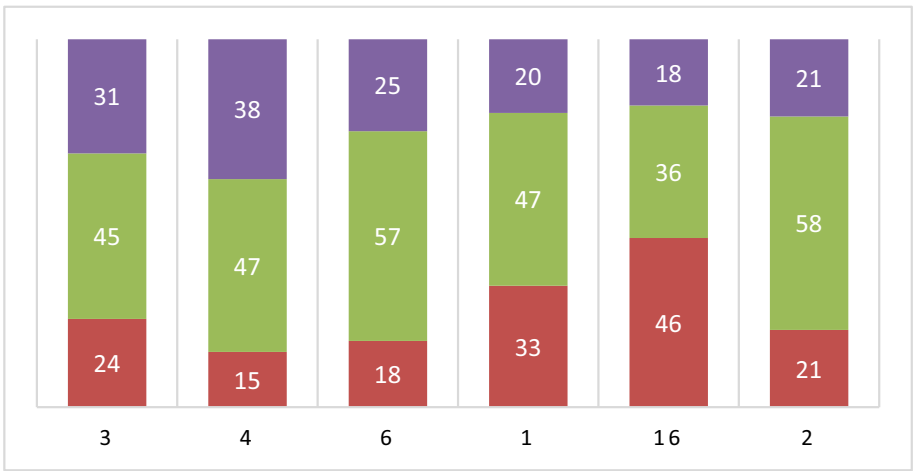
Students from Italy, Bulgaria and Poland were divided in their assessment of the impact of their lifestyle on aspects related to the SDGs. Thus, a third of the students surveyed are rather pessimistic about the impact of their lifestyle on achieving the SDGs, a third took a neutral position, and a third of respondents look to the future with hope, believing that their lifestyle affects the achievement of sustainable development goals (Fig. 2a–c).

A third of the students surveyed from the Central Asian republics do not see any connection between their future profession and the goals of sustainable development, however, a third of the respondents believe that the profession in which they are studying is related to the goals of sustainable development. It should be noted that students of engineering and technical specialties to a greater extent associate their profession with the goals of sustainable development.

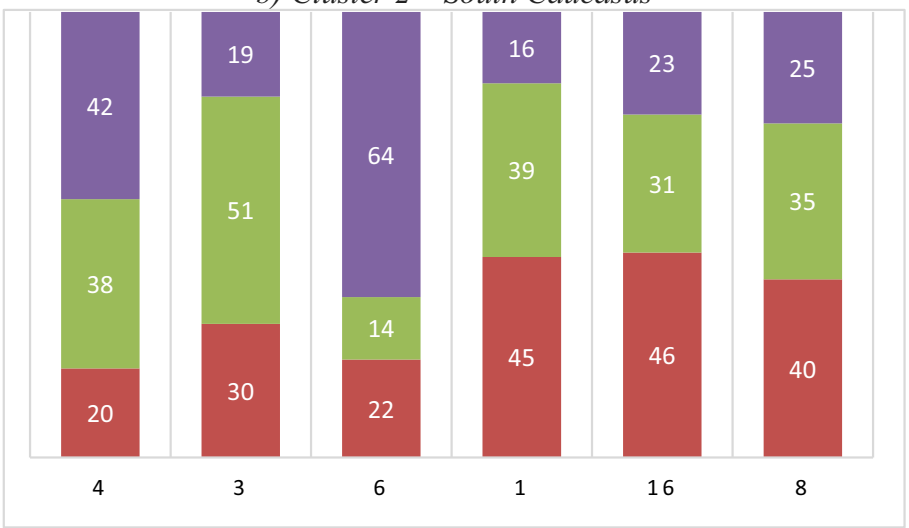
A third of the surveyed university students in Georgia and Armenia also do not see any connection between their future profession and the goals of sustainable development, a little more than a third took a neutral position, and less



a) Cluster 1 – Central Asia



b) Cluster 2 – South Caucasus



c) Cluster 3 – the EU

Fig. 1 Assessment of the situation over the last 2 years for 6 goals chosen by students (the bottom row shows numbers of SDGs)

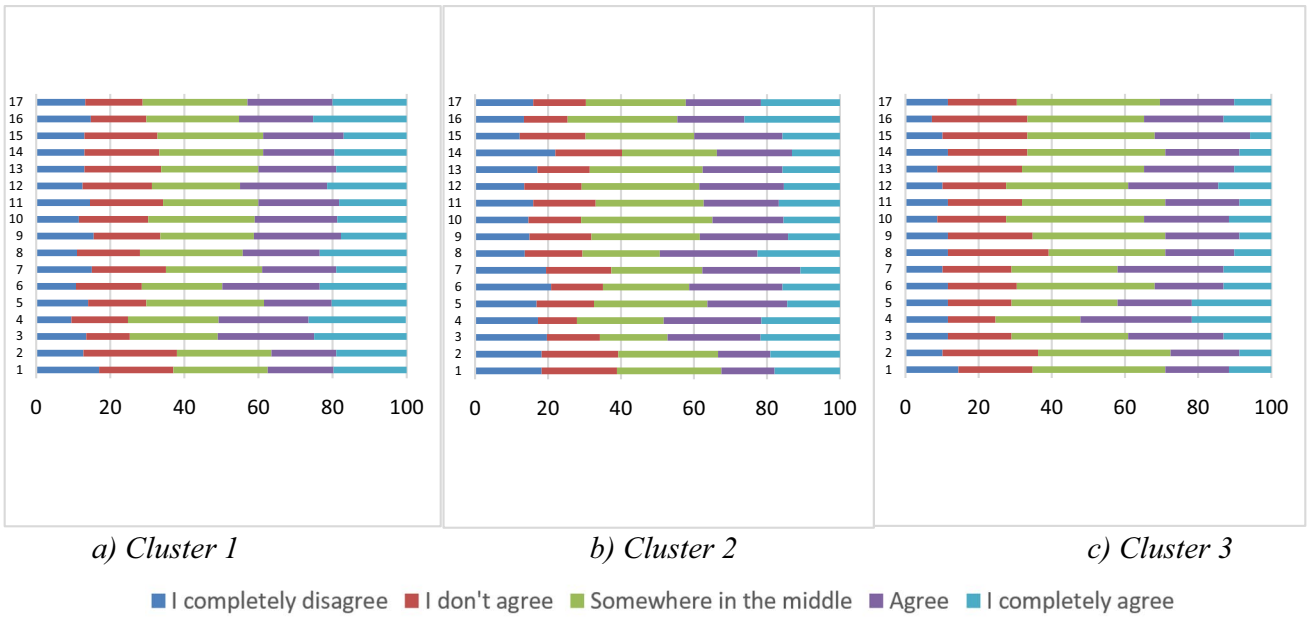


Fig. 2 The influence of lifestyle on aspects related to the SDGs, according to students (the left row shows numbers of SDGs)

than a third of the surveyed students believe that the profession in which they are studying is related to the goals of sustainable development.

Students from Italy, Bulgaria, and Poland are more optimistic; more than a third believe that the profession in which they are studying is related to sustainable development goals.

The opinions of students in the Central Asian republics were divided in assessing the connection of their curriculum with SDG topics, so a third of students encountered SDG topics during their studies, and a third of the students surveyed did not touch upon problematic issues while studying at the university.

When assessing the connection of their curriculum with SDG topics, only slightly more than 20% of students from Georgia and Armenia confirmed that they were exposed to all SDGs during their studies.

In contrast, just under 20% of students from the European Union, assessing the connection of their curriculum with SDG topics, were able to confirm that they were exposed to all SDGs during their studies.

Many students do not associate their future professional activities with the Sustainable Development Goals (SDGs) for several reasons, with a lack of awareness playing a leading role. According to a conducted study, the level of awareness about the SDGs among students, particularly in regional educational institutions, remains insufficiently high. This suggests that students often do not realize the potential link between their future profession and the possibility of contributing to the achievement of the SDGs.

Moreover, university curricula do not always contain sufficient information related to the SDGs, which leads to a lack of a clear connection between academic disciplines and the objectives of sustainable development. As a result, students do not perceive the SDGs as relevant or significant to their professional activities. The insufficient integration of sustainability topics into educational programs creates a gap in students' understanding of the importance of their participation in global sustainable development processes.

To address this issue, a revision of educational programs is required, with the aim of integrating the SDGs more deeply into academic courses. Increasing awareness among students about the importance of the SDGs and their relevance to various professional fields may help foster a more conscious attitude toward sustainable development and encourage their active involvement in achieving these goals through their professional activities.

More than half of the students surveyed at the universities studied believe that all important problems of humanity should be solved first, while among those who chose separately environmental, economic or social problems, the number of mentions of certain problems is on average the same, i.e., this reinforces the first thesis that all problems must be solved simultaneously (Fig. 3).

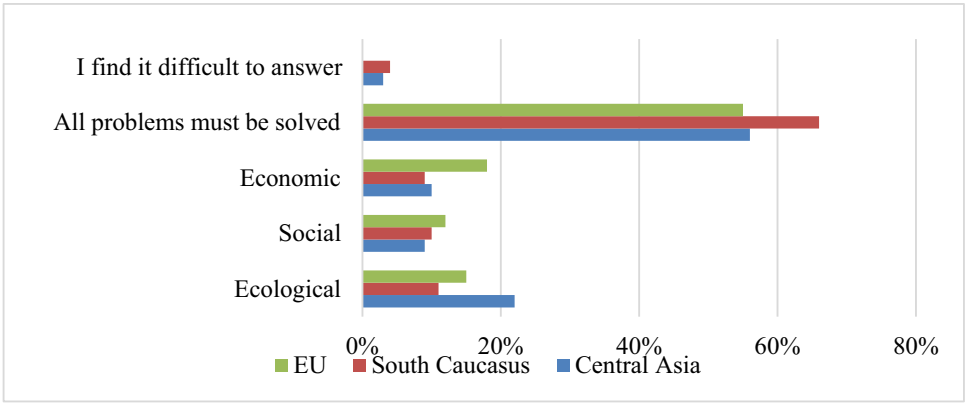


Fig. 3 What problems of humanity, in your opinion, should be solved first?

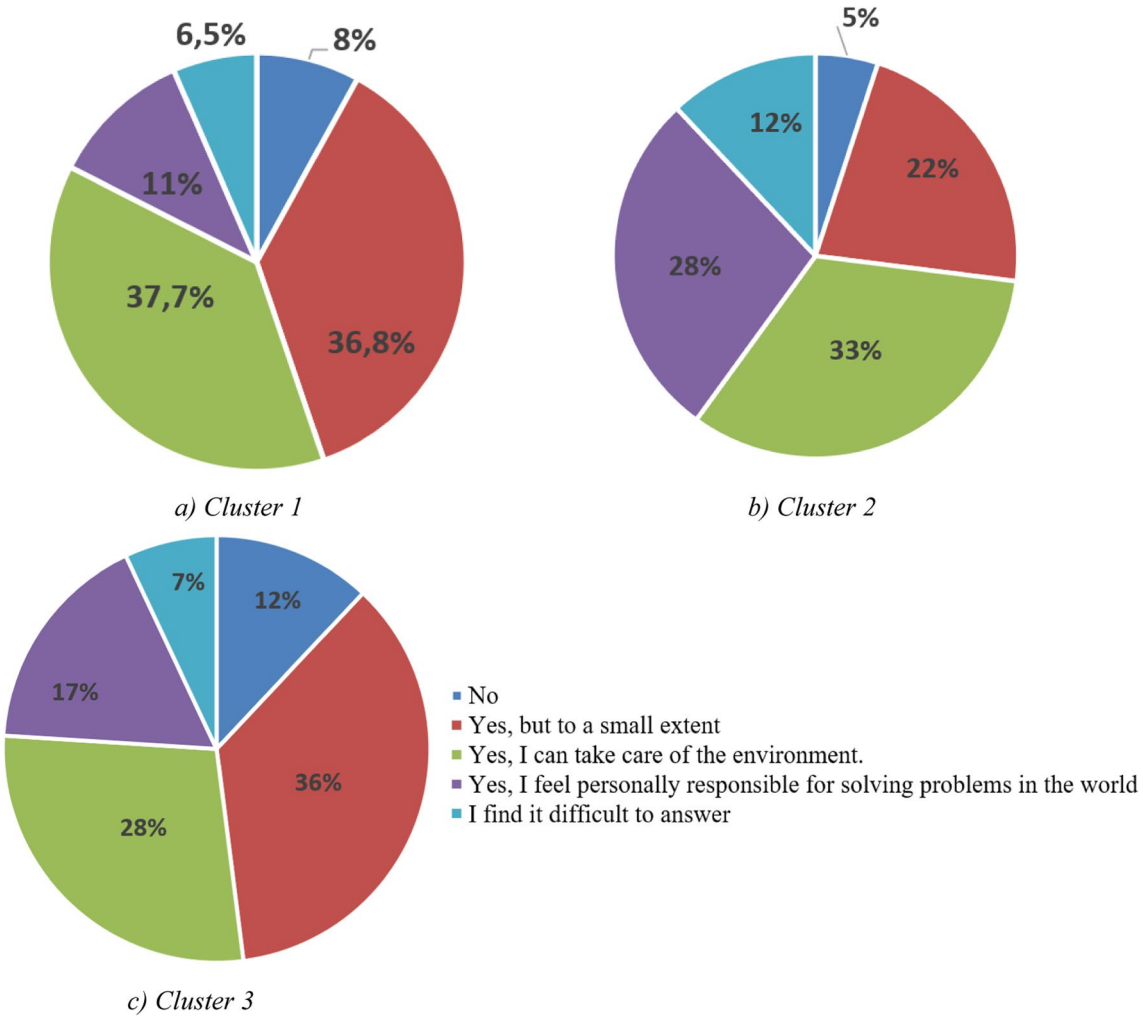


Fig. 4 Does anything depend on you in solving global problems?

In Central Asia, 37.7% of students indicated that they are capable of taking care of the environment, while 11% feel personally responsible for addressing global issues. However, 36.8% of respondents expressed uncertainty about their ability to make a significant impact on solving these problems (Fig. 4a).

Among students from Georgia and Armenia, 33% believe they can contribute to environmental care, 28% feel a personal responsibility for global challenges, and 22% remain unsure of their ability to influence decision-making in this area (Fig. 4b).

As for students from the European Union, 28% are willing to take action to protect the environment, 17% feel a sense of personal responsibility for solving global issues, but 36% are uncertain about their ability to make a significant difference (Fig. 4c).

The study showed that the younger generation acknowledges their responsibility toward future generations. More than a quarter of students across different countries believe they can influence global issues, with 28%, 27%, and 29% of respondents from Central Asia, the South Caucasus, and the European Union, respectively, expressing confidence in their ability to contribute to solving humanity's global challenges.

The results also highlight positive attitudes among students regarding their potential impact on addressing global problems. A significant portion of respondents—49% from Central Asia, 32% from the South Caucasus, and 45% from the European Union—indicated their willingness to change their behavior and lifestyle to help tackle global issues. Moreover, 37% of students from Georgia and Armenia stated they are prepared and capable of organizing events and engaging others in the process of finding solutions to these challenges.

The study also found that more than half of the surveyed teachers were knowledgeable about the global Sustainable Development Goals (SDGs). In response to the question, "Are you aware of the global Sustainable Development Goals, adopted and signed by 193 world leaders at the historic UN summit in September 2015?" 64% of teachers in Central Asia and 71% of those in the South Caucasus answered affirmatively.

The study also found that more than half of the surveyed teachers were knowledgeable about both the timeline and the number of Sustainable Development Goals (SDGs). When asked, "Do you know the time period for the implementation of the Sustainable Development Goals?" 67% of teachers from Central Asia, 54% from the South Caucasus, and 77% from European countries responded affirmatively, with EU teachers being the most informed.

Additionally, over half of the teachers surveyed were aware of the number of SDGs. In response to the question, "Do you know the number of Sustainable Development Goals and can you name one of them?" 61% of teachers from Central Asia, 67% from the South Caucasus, and 60% from European countries answered affirmatively.

When it came to sources of information about the SDGs, the majority of teachers from Central Asia (39%) indicated that social networks and the Internet were their main sources.

Opinions among European Union teachers were more varied: 27% mentioned social networks and the Internet, while 23% gained knowledge through informal training sessions (such as seminars, round tables, and conferences), and 18% received information while developing their own educational courses.

Similarly, teachers from Georgia and Armenia reported multiple sources of information: 23% gained their knowledge during their school or university education, 18% from social networks and the Internet, 15% from informal learning sessions, and 14% while creating educational materials (Table 2).

The majority of teachers in the Central Asian republics and countries of the European Union have an idea about the structures involved in sustainable development in their regions, so 56% and 77% of teachers from these countries answered positively to the question: «Are you aware of structures involved in sustainable development in your region?».

While teachers in the South Caucasus countries demonstrate less awareness of structures involved in sustainable development in their regions, 52% of teachers answered negatively to the question: «Are you aware of structures involved in sustainable development in your region?».

Those teachers who answered positively to the question about the structures involved in sustainable development in their regions most often point to the UN, UNESCO, various ministries and departments for environmental protection, and also indicate the mayor's office, administration and other government bodies.

The vast majority of teachers recognize sustainable development as a process of coordinated change, where the exploitation of natural resources, investment strategies, scientific and technological advancements, personal development, and institutional reforms are aligned to enhance the capacity to meet human needs. Over 80% of the surveyed teachers agreed that this definition best captures the essence of "sustainable development."

Among the 17 Sustainable Development Goals (SDGs), Central Asian educators showed the greatest interest in poverty eradication (Goal 1), good health and well-being (Goal 3), quality education (Goal 4), clean water and sanitation (Goal 6), decent work and economic growth (Goal 8), and industrialization, innovation, and infrastructure (Goal 9).

For university professors in the South Caucasus, the SDGs that garnered the most attention were poverty eradication (Goal 1), good health and well-being (Goal 3), quality education (Goal 4), clean water and sanitation (Goal 6), decent work and economic growth (Goal 8), and peace, justice, and strong institutions (Goal 16).

Table 2 Summary table of teacher's responses by cluster to questions

Question	Answer options	Cluster 1—Central Asia (%)	Cluster 2—Caucasus countries (%)	Cluster 3—EU countries (%)
Did you know about the SDGs adopted in September 2015	Yes	64	71	81
	No	36	29	19
Do you know the SDG implementation period?	Yes	67	53	77
	No	33	47	23
Do you know the number of SDGs	Yes	61	69	60
	No	39	31	40
Where did you learn about the SDGs from?	From the Internet	40	18	27
	From TV, newspapers	8	8	9
	While studying at the university	10	23	5
	At seminars, courses, conferences	13	15	23
	In the process of developing the course	9	14	18
	Other	0	6	9
	Don't know	22	16	9
Do you know local structures involved in sustainable development?	Yes	56	48	77
	No	44	52	23

In the European Union, the SDGs of greatest concern to university teachers were good health and well-being (Goal 3), quality education (Goal 4), clean water and sanitation (Goal 6), reducing inequalities (Goal 10), combating climate change (Goal 13), and peace, justice, and effective institutions (Goal 16).

Despite the fact that about half of the university teachers in the Central Asian republics note that over the past 2 years the situation in terms of goals that are significant to them has still not changed, they are more optimistic than their colleagues in the countries of South Caucasus and the European Union in observing what is happening in the states positive processes, thus, assessing the dynamics of changes over the past 2 years in goals that are significant to them, teachers of the Central Asian republics note that states have made progress in achieving such goals as quality education (40% think so), industrialization, innovation and infrastructure (39% think so) (Fig. 5a).

Assessing changes over the past 2 years in goals that are significant to them, most teachers in the South Caucasus countries note that their country has not progressed in achieving these goals, their level has mostly remained the same, or the situation has worsened. Thus, they note with great concern the deterioration of the situation with regard to the eradication of poverty, the achievement of peace, the effective functioning of legal and judicial institutions, the possibility of obtaining decent work and economic growth (Fig. 5b).

The majority of teachers in the European Union countries are even more pessimistic about the changes over the past 2 years in terms of goals that are meaningful to them. Just like their colleagues from Georgia and Armenia, they are concerned about the deteriorating situation with regard to peace and the effective functioning of legal and judicial institutions. About a third of teachers in the European Union countries observe a deterioration in the situation in all goals that are important to them (Fig. 5c).

The majority of surveyed teachers from the Central Asian republics, South Caucasus countries and European Union countries believe that education for achieving sustainable development goals is relevant to them as teachers.

So, to answer the question: «To what extent is education for sustainable development relevant to you as an educator?» 89%, 70% and 82% of the total number of teachers surveyed in the listed countries responded positively.

The study revealed that in the interests of achieving sustainable development goals, more than half of teachers try to include materials on sustainable development goals in their educational courses for students (lectures, practical classes, etc.).

Figure 6 shows the answer to the question «In the interests of achieving sustainable development goals, do I include materials on the following topics in my educational courses for students (lectures, practical classes, etc.)?».

Thus, to this question, the majority of teachers, regardless of the country, answered in the affirmative.

5 Conclusion

The results of a study conducted in higher educational institutions of Central Asia, the countries of South Caucasus, the countries of the European Union among students and teachers show that the majority of students do not know about the sustainable development goals, the information that students received through the Internet, the media, teaching is insignificant, the results of awareness teachers are higher than students.

It should be noted that the least informed students among the countries studied were university students in Georgia and Armenia, as more than 70% of students do not have information about the global sustainable development goals.

The study shows that environmental, social and economic issues are of major concern to students.

We also found in our research that students and teachers from South Caucasus countries and the European Union expressed the greatest concern about maintaining peace and stability in society, while their colleagues from Central Asian countries were more concerned about issues of clean water and sanitation.

The study revealed unevenness in knowledge about the goals of sustainable development among students of various fields of study at the universities studied. Thus, engineering and medical students are more informed about the SDGs than other specialties. We admit that students of pedagogical and socio-humanitarian fields may have less information about the SDGs compared to students of engineering, technical and medical fields for several reasons:

1. In engineering and medical fields there are often subjects directly related to the environment, sustainable development and ecology. For example, engineers may study environmental engineering, while health professionals may study public health and human ecology. While in pedagogical and socio-humanitarian areas these topics may be less emphasized or completely absent.

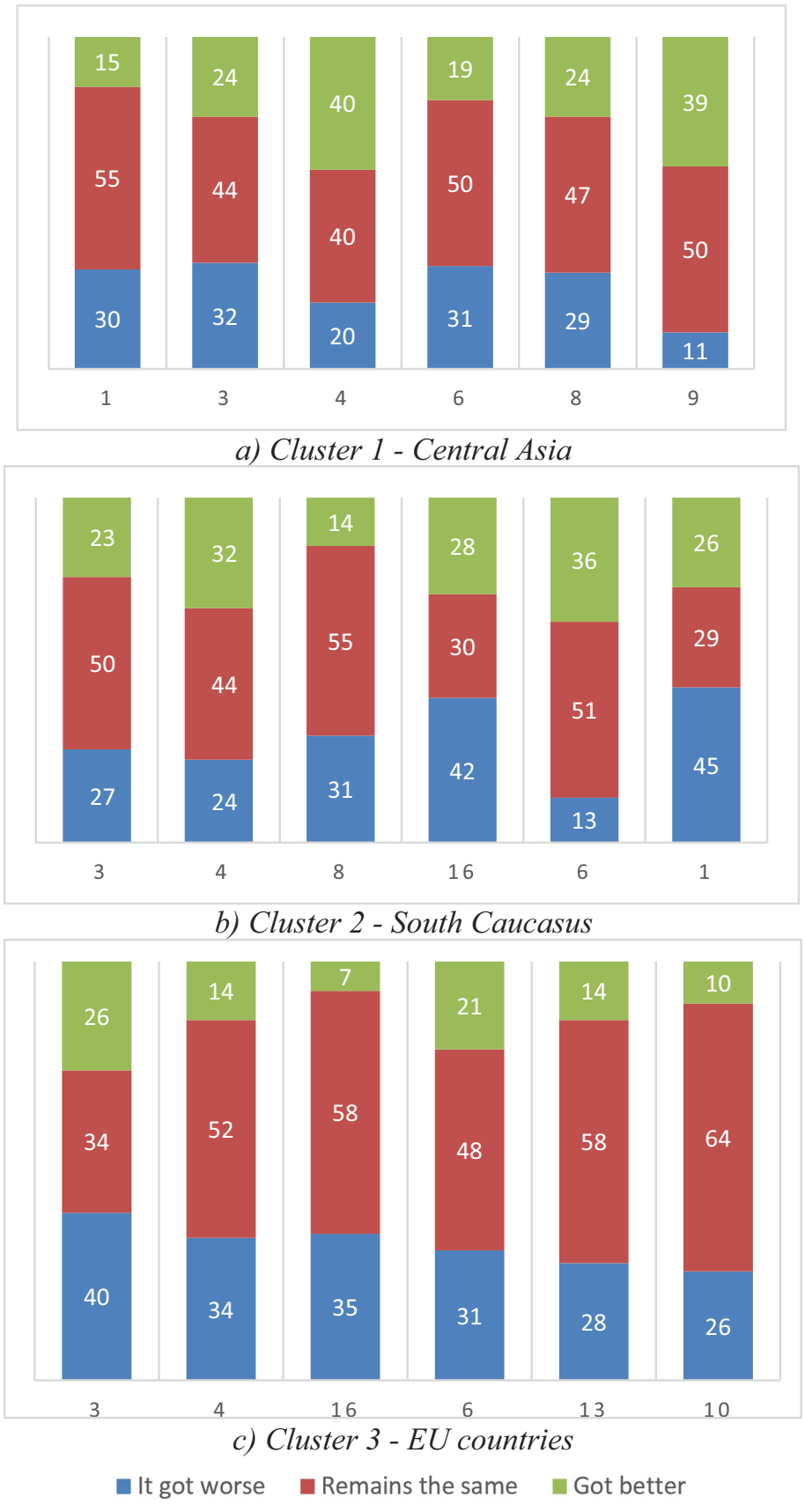


Fig. 5 Assessment of the situation over the last 2 years for 6 goals chosen by teachers (the bottom row shows numbers of SDGs)

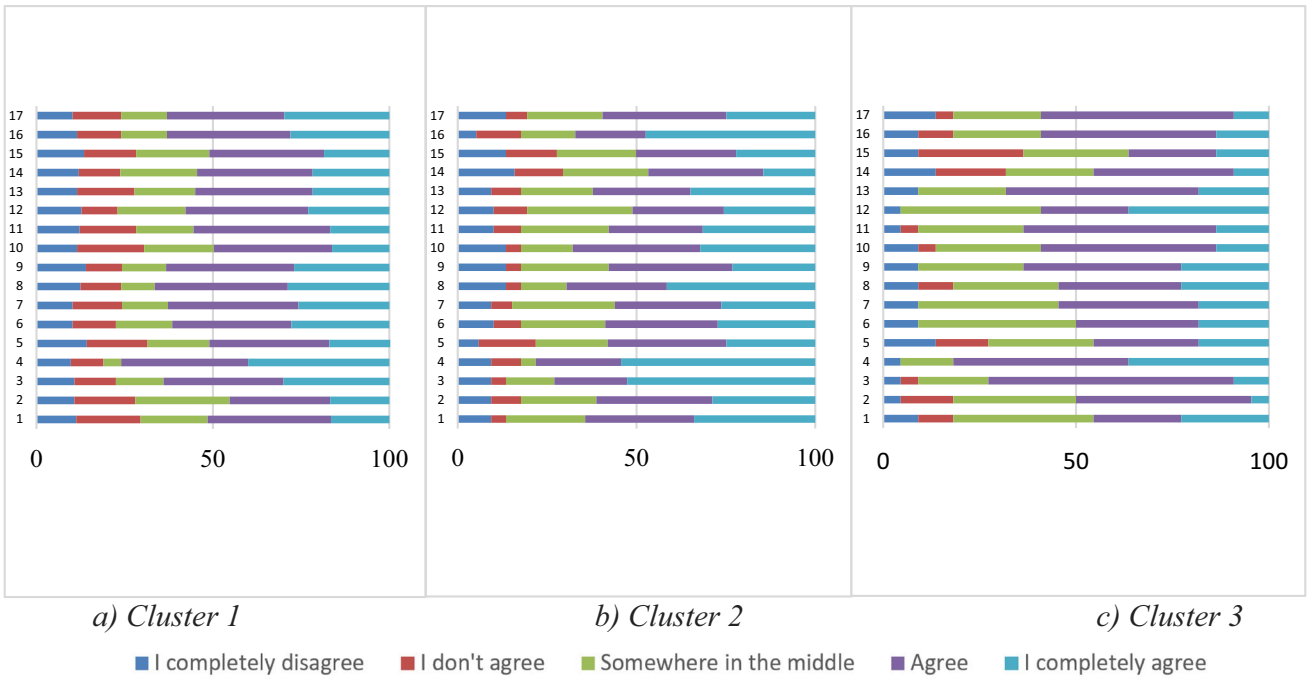


Fig. 6 Assessing the connection of educational courses with SDG topics (the left row shows numbers of SDGs)

2. Engineering and healthcare students are often focused on solving specific problems related to technology or health care, which often intersect with sustainability issues. While students of pedagogical and socio-humanitarian fields may be less concerned with technical and environmental aspects.
3. Engineering and medical higher education institutions could better develop specialized laboratories, research centers and courses dedicated to sustainable development. This ensures students have access to up-to-date information and resources on the topic.

However, in recent years, interest in issues of sustainable development has been growing in pedagogical and socio-humanitarian areas. Therefore, universities need to actively introduce courses and programs aimed at teaching students about sustainable development and its importance in various spheres of life. This should include the development of teaching materials, the organization of specialized workshops and projects, and the inclusion of sustainable development topics in the curricula.

Thus, while engineering and medical students may have more access to information about the SDGs in their curricula, the trend towards expanding educational opportunities for other disciplines also shows that interest and awareness of sustainable development in education in general is increasing.

Recommendations for universities:

University education programs should integrate sustainable development education across various disciplines, including ecology, economics, social sciences, and technology. This interdisciplinary approach will help students gain a comprehensive understanding of sustainability, allowing them to develop the relevant skills necessary to address global challenges. By incorporating sustainable development into multiple fields of study, universities can ensure that students are equipped to consider environmental, social, and economic factors in their future careers.

In addition to academic integration, universities should actively promote awareness and engagement with sustainable development issues. Programs should include activities such as lectures, seminars, roundtable discussions, and involvement in community development projects. These initiatives will raise awareness not only among students but also within the broader community, encouraging civic responsibility and participation in sustainability efforts.

Students should be required to engage in hands-on sustainability projects and research. Practical experiences, such as analyzing environmental data, developing sustainability strategies, or participating in social initiatives, will provide students with the opportunity to apply theoretical knowledge to real-world challenges. Such activities are

crucial for cultivating critical thinking and problem-solving skills while simultaneously fostering a sense of responsibility towards global and local sustainability issues.

Universities should also focus on promoting international cooperation and knowledge exchange in the field of sustainable development. This can be achieved through student and faculty exchange programs, joint international research initiatives, and participation in global sustainability courses. By fostering cross-border collaboration, universities can expose students to diverse perspectives and solutions to global sustainability challenges, encouraging a more interconnected and collaborative approach to education.

Collaboration with local communities and industry partners is another vital aspect of sustainable development programs. Universities should work alongside local stakeholders to implement region-specific sustainability projects. This approach not only benefits local communities by addressing immediate environmental and social issues but also provides students with the chance to gain practical experience and witness the tangible impact of their efforts.

A key component of any sustainability initiative is the systematic evaluation and monitoring of program outcomes. Universities should establish processes to assess the effectiveness of their sustainability programs and measure their impact on both society and the environment. Regular assessments will help institutions adapt and improve their approaches, ensuring that their efforts are making meaningful contributions toward sustainability goals.

Finally, universities should explore the integration of emerging technologies, such as artificial intelligence, renewable energy systems, and data analytics, into sustainability education. By embracing technological advancements, universities can equip students with cutting-edge tools to address modern sustainability challenges, preparing them to lead the global transition toward a more sustainable future.

The successful implementation of these recommendations will require coordinated efforts from educational institutions, government agencies, non-governmental organizations, and private sector partners. Working together, these stakeholders can drive long-term progress in sustainable development and contribute to the creation of a more resilient and responsible society.

The study presents several aspects that should be considered when interpreting its results. First, there is some regional inequality in the sample of respondents, which may affect the accuracy of group comparisons. Second, the study covers universities from only three regions, limiting the generalizability of the findings to other parts of the world with different educational systems. Additionally, the results are based on self-assessments by respondents, which may reflect their subjective perceptions.

This research contributes to the understanding of the level of awareness of the Sustainable Development Goals (SDGs) among students and faculty in Central Asia, the South Caucasus, and the European Union. The collected data highlight key knowledge gaps and regional specificities, which are important for the further improvement of educational programs.

The developed recommendations for integrating sustainability themes into university curricula may help equip students with the skills needed to effectively respond to global challenges. The applied methodological approach can be used in future studies to assess SDG awareness in other regions.

Future research could focus on the development and testing of new methods for integrating sustainability into the educational process.

Author contributions The study was supervised by Bespalyy S. The methodology was developed by Alnazarova G. Data processing in the SPSS program was carried out by Petrenko A. Vincenzo Nunzio Scalcione, P. Vitliemov, A. Sichinava, A. Kaptsov made an equal contribution to collecting information, conducting the survey and developing recommendations based on the results of the article. All authors reviewed the manuscript.

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Data availability The data was obtained through a survey of students and teachers at these universities and subsequently processed using the IBM SPSS Statistics 27 program. The general database of the survey results is at the disposal of the authors of the article, and can be provided upon request. The data was obtained through a survey of students and teachers at these universities and subsequently processed using the IBM SPSS Statistics 27 program. The general database of the survey results is at the disposal of the authors of the article, and can be provided upon request.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate It should be noted that due to the lack of an institutional ethics board to approve the studies, it was not possible to apply for Research Ethics Board (REB) approval. There are no institutional ethics boards for approval of participation in the countries where the study was conducted. This academic restriction resulted in an exemption from the requirement for ethical approval for the study. In this study, information was collected through online and paper questionnaires and then processed anonymously. The respondents did not leave any confidential information to the study authors. All respondents who answered the questionnaire gave informed consent that their answers would be used to conduct and publish the study. Respondents under the age of 18 did not participate in the study.

Competing interests The authors declare no competing interests.

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