

Teaching For Sustainability In Higher Education: Methods, Barriers, And Institutional Practices In Kazakhstan

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Abstract: *The integration of the Sustainable Development Goals (SDGs) into higher education requires not only the inclusion of relevant content in academic curricula but also a shift in pedagogical approaches toward more active, interdisciplinary, and context-oriented forms of teaching and learning. This study analyzes the effectiveness of various teaching methodologies for sustainable development in Kazakhstani universities, with particular attention to active learning formats, case-based methods, the use of digital tools, and interdisciplinary integration. The empirical part is based on surveys of students and faculty members, as well as the implementation of a modular teaching guide covering all 17 SDGs. The results indicate that project-based learning and assignments related to local case studies significantly enhance student engagement and support the development of key competencies. However, barriers remain, particularly in technical disciplines, due to a lack of methodological resources and institutional support. The article concludes with practical recommendations for universities aimed at systematically integrating the SDGs into educational practice and strengthening pedagogical training for faculty.*

Keywords: *Awareness of the SDGs, education for sustainable development, interdisciplinary teaching, SDG education in universities, sustainable development goals, teaching methods.*

1. INTRODUCTION

In the face of escalating global challenges—including climate change, social inequality, and the depletion of natural resources—the role of education in fostering sustainable development has gained unprecedented importance. Higher education institutions are increasingly recognized not only as centers of academic knowledge production but also as agents of societal transformation. The adoption of the 2030 Agenda for Sustainable Development and the articulation of the 17 Sustainable Development Goals (SDGs) have further emphasized the need to equip students with the competencies, values, and practical skills required to build a more equitable and sustainable future.

Kazakhstan, like many other countries in Central Asia, is confronted with a dual imperative: the modernization of its higher education system and the urgent necessity to address environmental and social sustainability challenges. In recent years, Kazakhstani universities have undertaken initiatives to integrate the SDGs into curricula, institutional strategies, and educational practices. However, the success of these efforts largely hinges on the teaching methodologies employed. Traditional lecture-based formats often fail to adequately address the interdisciplinary and practice-oriented dimensions embedded in the SDG framework.

This study examines innovative pedagogical approaches implemented in sustainability-related courses at Kazakhstani universities. Special attention is given to active learning strategies, case-based methods, digital tools, and interdisciplinary integration. Drawing on existing research and the authors' experience in developing and implementing a modular teaching guide that encompasses all 17 SDGs, the article evaluates the effectiveness of these approaches in terms of student engagement, conceptual understanding, and the development of practical problem-solving skills.

The findings aim to identify effective pedagogical practices in education for sustainable development (ESD) and to provide actionable recommendations for educators, curriculum developers, and university administrators seeking to transform higher education in line with the principles of sustainability.

2. LITERATURE REVIEW

The integration of the Sustainable Development Goals (SDGs) into higher education has been recognized globally as a central task of contemporary academic policy. Universities play a critical role in preparing professionals capable of addressing the complex global challenges outlined in the United Nations 2030 Agenda [1]. Scholars emphasize that effective education for sustainable development (ESD) requires not only the inclusion of relevant content in curricula but also a transformation of teaching methodologies—towards more practice-oriented, interdisciplinary, and interactive formats [2, 3].

One of the most widely acknowledged approaches is the adoption of active learning strategies. Brundiens et al. highlight that engaging students in real-world projects, internships, and service-learning initiatives in collaboration with external stakeholders fosters systems thinking, stakeholder engagement skills, and the practical application of knowledge [4]. Case-based learning has also gained significant traction. Krakowska demonstrates that international case studies substantially enhance students' awareness of the SDGs while promoting critical thinking and social responsibility [5].

Further studies reveal that project-based learning enables students to develop sustainability-related competencies through teamwork, problem-solving in local communities, and the integration of knowledge across disciplines [6]. These methods facilitate a shift in the instructor's role—from knowledge transmitter to learning facilitator—and help cultivate students' experience with cross-sectoral collaboration [7]. Similarly, problem-based learning has shown strong results in motivating engineering students to engage with sustainability topics, as evidenced by findings presented at the international CIEES conference in Bulgaria [8].

Another key development is the incorporation of digital technologies. Online courses, multimedia platforms, and digital simulations expand access to SDG-related education and support flexible interaction formats with learners [9]. Holmes et al. emphasize the potential of online education to implement core ESD principles—such as learner autonomy, collaborative learning, and real-world relevance [10]. Immersive technologies, including virtual and augmented reality (VR/AR), are increasingly used to promote deeper understanding of environmental and social issues and enhance students' emotional engagement [11].

Additional research highlights the importance of integrating the SDGs into university programs. For instance, Al Husban [12] examines the impact of SDG integration on students' environmental behavior in Jordan. Safari et al. [13] analyze approaches to SDG implementation in higher education, noting differences between high-income and low-income countries. Filho et al. [14] underscore the role of European universities in accelerating SDG achievement. Volkova et al. [15] present a case study from Ural Federal University on sustainable development project implementation. Pugh et al. [16] offer a systematic review of

SDG teaching in higher education, while Bautista-Puig et al. [17] analyze trends in the inclusion of SDGs in university and research institution activities from 2000 to 2017.

An interdisciplinary approach is widely regarded as essential for educating future sustainability professionals. As noted by Aleixo et al. [18], integrating multiple disciplines within educational modules enables students to perceive connections among the economic, social, and environmental dimensions of sustainability and fosters systems thinking. Studies conducted in European and U.S. universities demonstrate that interdisciplinary courses, dual-degree programs, and co-teaching strategies enhance the perception of the SDGs as a comprehensive and interconnected framework [19]. Biasutti and Frate emphasize that such programs are particularly effective when grounded in practice-oriented learning and linked to local contexts [20].

Institutional strategies also play a crucial role in the successful integration of the SDGs. Leal Filho et al. argue for embedding sustainability principles in university strategic plans, establishing dedicated sustainability centers, coordination teams, and progress monitoring mechanisms [21]. Owens highlights that institutionalizing SDG initiatives enhances their legitimacy and strengthens partnerships with external stakeholders—including employers, government bodies, and local communities [22]. However, universities often face several barriers in practice, such as a lack of methodological resources, faculty resistance, and the absence of standardized tools for assessing SDG integration [23]. Avila et al. report that many universities lack clear action plans for sustainable development despite expressing formal support [24]. A comparative study of universities in Central Asia, the South Caucasus, and the European Union confirms considerable variation in institutional strategies and underlines the need for context-specific approaches tailored to regional settings, including Kazakhstan [25-27].

In summary, the literature indicates that the integration of the SDGs into higher education requires a comprehensive approach—combining active and digital learning methods, interdisciplinary curricula, and robust institutional support. International experience demonstrates that the most successful models are built on student engagement in real-world projects, strategic program transformation, and close collaboration with society. These practices are highly adaptable to the Central Asian context, including Kazakhstan, where there is growing interest in systemic SDG integration within the educational process.

3. METHODOLOGY

This study employed a mixed-methods approach, combining a sociological survey of students and faculty members with an analysis of the implementation of a modular teaching guide on the Sustainable Development Goals (SDGs) within the curriculum of a Kazakhstani university. The primary objective of the methodological design was to explore perceptions of the teaching methods used to deliver SDG-related content, including active, digital, and interdisciplinary formats.

The empirical component consisted of a questionnaire administered to undergraduate students and academic staff. The survey assessed respondents' awareness of the SDGs, their engagement in sustainability-related educational activities, and their evaluation of different pedagogical methods. In addition, semi-structured interviews with faculty members were conducted to gain deeper insights into the challenges and opportunities associated with integrating sustainability themes into disciplinary courses.

The practical component involved observing the application of a modular SDG teaching guide that encompasses all 17 goals. The guide was piloted within a university course featuring case studies, assignments, discussions, and assessment tools. Feedback collected from students and instructors was used

to evaluate the perceived relevance of active learning methods and their effectiveness in fostering sustainability competencies.

4. RESULTS

The findings underscore the relevance and demand for integrating SDG content into undergraduate and graduate programs. According to the survey results, only 38.6% of students were able to correctly name more than one Sustainable Development Goal, while 64.3% reported encountering the concept of the SDGs for the first time during their university studies. This indicates insufficient coverage of sustainability topics within existing curricula.

Nonetheless, 82.1% of students responded positively to the use of case-based and problem-oriented tasks, highlighting their practical orientation and contribution to the development of critical thinking skills. Respondents emphasized that group projects, teamwork, and class discussions enhanced their understanding of the interconnections between the social, environmental, and economic dimensions of sustainable development.

Feedback gathered from the pilot implementation of the teaching guide revealed that assignments related to local sustainability challenges and real-sector examples generated the greatest student engagement. Learners actively participated in discussions on issues such as water resource management, energy efficiency, and sustainable consumption. More than 70% of students indicated that the course helped them to recognize the importance of individual contributions to achieving the SDGs.

Among faculty members, 64.7% reported experiencing methodological difficulties in integrating SDG-related content into disciplinary courses, particularly in technical and economic fields. At the same time, over half expressed willingness to adopt the teaching guide, provided there is adequate administrative and methodological support from the university.

The interviews with instructors highlighted that case-based learning, structured discussions, and interdisciplinary student projects were considered the most valuable teaching strategies. However, participants also noted a lack of professional development programs on sustainable development and the absence of a clearly defined institutional strategy at the university level.

Overall, the results confirm that active and practice-oriented teaching methods resonate positively with students, contribute to the development of key competencies, and enhance engagement in the learning process. However, the systemic integration of the SDGs into higher education requires comprehensive institutional support and the advancement of faculty competencies in sustainability education.

5. DISCUSSION

The results of the study demonstrate that the integration of the Sustainable Development Goals (SDGs) into the educational process is perceived by students as both relevant and practically meaningful. Although the initial level of SDG awareness among students was limited, active learning methods—particularly case studies, project-based assignments, and group discussions—elicited a high degree of interest and engagement. This is evidenced by both the survey data and the qualitative feedback collected during the pilot implementation of the course.

Of particular importance is the observation that students responded most positively to modules and assignments tailored to local contexts and real-life regional challenges. These elements of the course not only enhanced learning motivation but also fostered a sense of ownership and personal responsibility

among learners. Engaging in case discussions related to specific environmental and social issues stimulated students' analytical thinking and encouraged practical reflection on global sustainability challenges.

Feedback from instructors also indicates a growing interest in sustainability-related topics and recognition of the potential of the proposed teaching methods. At the same time, several persistent barriers were identified that hinder the full integration of SDGs into existing courses: limited time, a lack of methodological resources, and insufficient confidence in delivering interdisciplinary content. Nevertheless, the experience of implementing the modular teaching guide suggests that when equipped with ready-to-use tools and contextually adapted materials, faculty members are willing to adopt active formats and incorporate sustainability topics into their disciplines.

During the course of the study, more than 60% of students reported that integrated courses—where instructors embedded sustainability themes into their disciplines—had a significant impact on their attitudes toward the topic. Such inclusion of sustainability and environmental issues across various academic subjects helps students recognize the importance of a comprehensive, systems-based approach to addressing global challenges (Fig. 1).

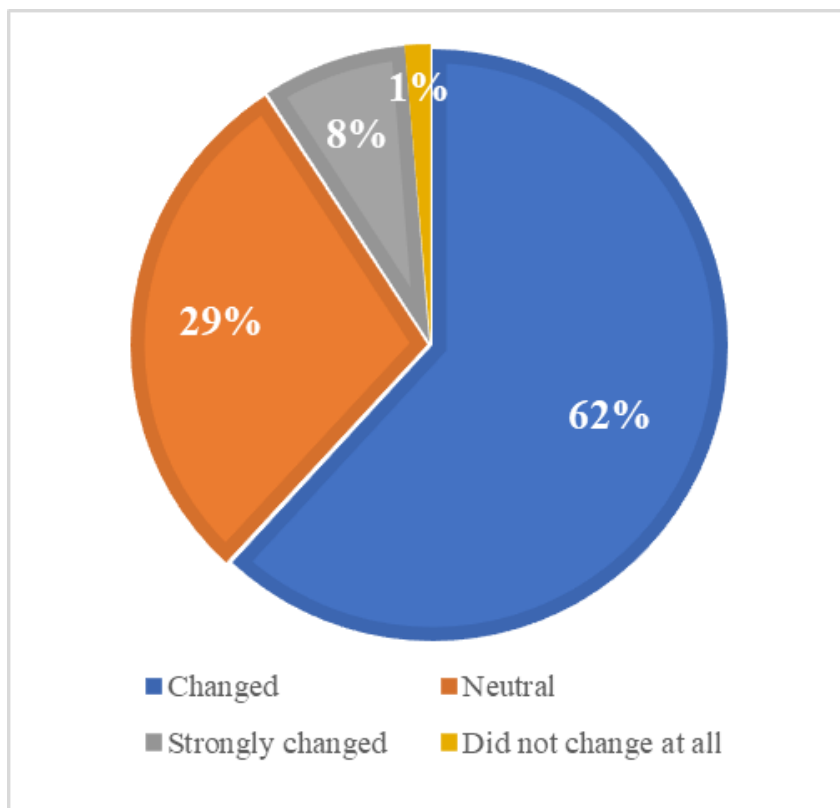


Fig. 1. Do you feel that the course has changed your attitude toward sustainable development?

To better understand the perception of different pedagogical approaches to teaching sustainable development and to assess their applicability in the context of a Kazakhstani university, a qualitative evaluation was conducted based on student and faculty feedback (Table 1).

Table I. Comparison of Teaching Methods for the SDGs

Teaching Method	Student Evaluation	Barriers to Implementation
Case-based learning	Very high engagement; fosters systems thinking	Requires teacher training and access to prepared case materials
Project-based learning	Enhances practical skills and sense of responsibility	Limited time within curriculum; lack of partnerships with external organizations
Group discussions	Develops critical thinking and argumentation skills	Dependent on group dynamics and moderation quality
Online modules and digital tools	Convenient access; lower engagement reported	Some instructors lack confidence in using digital technologies
Tests and assignments	Viewed as supplementary rather than central	Widely used but may not build long-term sustainability skills
Local examples and contextualization	Highest approval; increases personal relevance and motivation	Requires development of region-specific content

Overall, the data suggest that active and practice-oriented approaches are the most effective for teaching the SDGs. These methods not only enhance engagement and modernize the learning experience but also help students acquire competencies aligned with sustainable development, including systems thinking, the ability to analyze complex interconnections, teamwork, and the design of responsible solutions. Sustained results, however, require institutional support—such as curriculum reform, faculty training, and the systematic adoption of interdisciplinary educational practices.

The relevance of SDG integration into higher education in Kazakhstan is driven both by the country's international commitments and its internal challenges in modernizing the education system. In the context of environmental threats, social inequalities, and the need for a technological transition, building sustainability competencies among students becomes an essential element in the preparation of future professionals. While individual initiatives to incorporate the SDGs into curricula are already underway, a comprehensive and systemic approach remains in its early stages of development.

International organizations play a key role in advancing this agenda. Programs led by the United Nations, UNDP, UNESCO, and the World Bank not only provide strategic guidance but also offer expertise, institutional support, and tools for Central Asian countries, including Kazakhstan. Joint initiatives are currently underway in areas such as education for sustainable development (ESD), the development of sustainability indicators, monitoring systems, and training programs for the green economy. Kazakhstan's active participation in global rankings—such as the Times Higher Education Impact Rankings—reflects the growing interest of local universities in sustainability.

Against this background, the results of the present study and the pilot implementation of the authors' teaching guide show that students are open and responsive to sustainability topics, particularly when presented through locally relevant content and active learning formats. This underscores the need to not only adapt international best practices to regional contexts but also to expand national education policy in the direction of sustainable development. The methodology developed within this project may thus contribute to a broader transformation of higher education in Kazakhstan.

6. CONCLUSIONS

This study has identified both strengths and limitations in the process of integrating the Sustainable Development Goals into higher education. Through the pilot implementation of a modular teaching guide and an assessment of how various pedagogical approaches were received by students and faculty, the study confirms the high effectiveness of active and practice-oriented learning formats. Case-based methods, project work, and real-life discussions demonstrated the greatest potential for fostering sustainability competencies and stimulating student engagement.

The educational impact was significantly amplified when course content was linked to local realities and adapted to the regional context. Such an approach enabled students to develop not only cognitive knowledge but also a values-based foundation for sustainable behavior. At the same time, organizational and methodological challenges faced by instructors were identified, highlighting the need for institutional support at the university level.

Based on the findings, the following recommendations are proposed:

- Ensure the institutional embedding of SDG-related content in academic programs, with an emphasis on interdisciplinary and practice-oriented approaches;
- Develop and implement standardized SDG modules that can be adapted to various academic disciplines;
- Expand the use of teaching materials tailored to the local context and provide instructors with ready-to-use case studies and assignments;
- Establish systematic methodological and organizational support for faculty, including professional development and intra-university knowledge exchange;
- Increase student involvement in project-based activities related to sustainability issues within their respective fields of study.

In conclusion, the development of sustainable thinking and behavior among future professionals requires not only the modernization of curriculum content but also a fundamental shift in pedagogical foundations. The results and practices presented in this study may serve as a basis for advancing educational models that align with national and global sustainable development objectives.

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