

FRI-2G.307-1-ERI-04

EXTENDING SERVICE-LEARNING FOR SUSTAINABLE ENERGY ACCESS. A COLLABORATIVE CASE STUDY BETWEEN TECHNICAL UNIVERSITY OF CIVIL ENGINEERING BUCHAREST AND THE UNIVERSITY OF RUSE "ANGEL KANCHEV"

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***Abstract:** This paper presents the extension of the Service-Learning initiative "Illuminating Sustainable Futures – Solar Empower, Energize Tomorrow" from the Technical University of Civil Engineering Bucharest (UTCB) to the University of Ruse "Angel Kanchev" (RU), Bulgaria, within the Erasmus+ GIRLS project (2022-1-ES01-KA220-HED-000089166). The study highlights how Service-Learning, as a pedagogical method, connects academic knowledge with real-world challenges in sustainable energy access. The project implementation at RU was structured into four phases: preparatory activities, the first implementation stage, the second implementation stage, and the final stage of evaluation and dissemination. Each phase combined academic, community, and stakeholder engagement, offering students opportunities to develop technical skills, civic responsibility, and critical thinking through experiential learning. Results indicate strengthened institutional cooperation, enhanced student competencies, and increased awareness of sustainable energy practices in the local community. The paper further compares the implementation at UTCB and RU, identifies key lessons learned, and proposes recommendations for embedding Service-Learning into higher education curricula with a focus on sustainability.*

***Key words:** Service-Learning; Sustainable Energy; Higher Education; Experiential Learning; Community Engagement; Erasmus+ GIRLS Project.*

INTRODUCTION

In recent years, higher education has increasingly embraced innovative pedagogical approaches that seek to bridge the gap between theoretical knowledge and real-world application. Among these, Service-Learning has emerged as a powerful method to integrate academic learning with civic responsibility and community engagement. By engaging students in activities that respond to societal needs while simultaneously addressing curriculum content, Service-Learning has proven to enhance both student learning outcomes and community development.

Within this broader context, the Erasmus+ GIRLS project (Gendered Innovation in Renewable Learning for Sustainability, 2022-1-ES01-KA220-HED-000089166) has provided a fertile ground for the application and dissemination of Service-Learning practices across European universities. The initiative “Illuminating Sustainable Futures – Solar Empower, Energize Tomorrow” was initially developed at the Technical University of Civil Engineering Bucharest (UTCB), Romania, as a means to address the pressing global challenge of ensuring sustainable and affordable energy access. The project has combined academic expertise, community-based activities, and student-driven innovation to promote awareness and practical solutions in renewable energy, with a particular focus on solar energy technologies.

Encouraged by the success of the activities at UTCB, the project was extended to Bulgaria through a collaboration with the University of Ruse “Angel Kanchev” (RU). This extension marked a significant step toward expanding the geographic and cultural reach of the initiative, while also strengthening cross-border academic partnerships. The inclusion of RU provided a valuable opportunity to adapt the Service-Learning approach to a new institutional and community context, thereby enriching the pedagogical framework and reinforcing the sustainability dimension of the project.

The collaboration at RU involved faculty members, students, and external stakeholders working together on a variety of activities that promoted both academic learning and community engagement. By integrating scientific concepts with practical demonstrations and participatory workshops, the project fostered a dynamic educational environment where students could apply their knowledge to tangible challenges faced by the local community. The phased implementation at RU, covering preparatory activities, implementation stages, and final evaluation and dissemination, demonstrated how Service-Learning can function as a continuum of engagement, reflection, and societal impact.

Furthermore, the extension of the project highlighted the importance of cross-institutional cooperation in advancing sustainable education practices. The partnership between UTCB and RU not only facilitated the exchange of knowledge and best practices but also created a platform for innovation and dialogue on climate-conscious behavior, renewable energy adoption, and the role of universities in promoting sustainable development.

THEORETICAL AND METHODOLOGICAL FRAMEWORK

Service-Learning in Higher Education

Service-Learning (SL) has evolved over the past decades as a distinctive pedagogical strategy that integrates community service with structured opportunities for learning and reflection. Unlike traditional volunteering, SL is directly connected to academic content, requiring students to apply their disciplinary knowledge to address authentic community challenges. This dual purpose—advancing academic learning while fostering civic engagement—has positioned SL as a transformative practice in higher education.

The educational literature consistently emphasizes the benefits of SL, including the development of critical thinking, problem-solving, and leadership skills, alongside a stronger sense of social responsibility. Within STEM disciplines, and particularly in engineering and mathematics, SL has been identified as a means to contextualize abstract concepts, enhance student motivation, and improve knowledge retention through experiential learning.

Alignment with the Sustainable Development Goals (SDGs)

The project “*Illuminating Sustainable Futures – Solar Empower, Energize Tomorrow*” aligns closely with the United Nations Sustainable Development Goals, particularly:

SDG 7 (Affordable and Clean Energy): promoting access to reliable, sustainable, and modern energy services, with solar energy as a focal point.

SDG 11 (Sustainable Cities and Communities): fostering urban resilience and sustainable community practices through energy awareness.

SDG 13 (Climate Action): encouraging behavioral change and innovation in response to climate change challenges.

By linking Service-Learning with the SDGs, the project moves beyond classroom instruction to actively engage students in global sustainability discourse, while simultaneously responding to local community needs.

Methodological Approach

The methodological design of the project was rooted in the principles of experiential and collaborative learning. The activities followed a cyclical process of engagement, application, reflection, and dissemination, enabling students to connect theoretical insights with hands-on experiences.

Key methodological components included:

Interdisciplinary Collaboration: students from mathematics, engineering, and education worked together, guided by faculty mentors.

Community Involvement: local schools, civic groups, and stakeholders were engaged as partners in awareness campaigns and workshops.

Experiential Activities: practical demonstrations of solar energy solutions, interactive workshops, and prototyping encouraged active participation.

Reflection and Dialogue: structured discussions, feedback sessions, and thematic reflections supported critical thinking and knowledge integration.

Dissemination and Visibility: results were shared with academic and community audiences through presentations, workshops, and open discussions.

The Rationale for Extending to the University of Ruse "Angel Kanchev"

The extension of the project to the University of Ruse "Angel Kanchev" (RU) was not only a geographical expansion but also a methodological enrichment. The collaboration allowed for the adaptation of the SL framework to a different institutional culture and socio-economic environment. While UTCB had established a model within the Romanian higher education context, RU offered a complementary perspective rooted in Bulgarian academic traditions and community needs.

This cross-border cooperation contributed to:

Strengthening academic networks within the Erasmus+ GIRLS project.

Sharing best practices in sustainability education.

Expanding the impact of SL activities beyond national boundaries.

Encouraging intercultural dialogue and comparative reflection among students and faculty.

Through this methodological approach, the project created a continuum of academic and civic engagement, ensuring that the educational impact was both deep and sustainable.

IMPLEMENTATION PHASES AT THE UNIVERSITY OF RUSE "ANGEL KANCHEV" (RU)

The extension of the Service-Learning initiative "*Illuminating Sustainable Futures – Solar Empower, Energize Tomorrow*" to the University of Ruse "Angel Kanchev" (RU) followed a carefully planned sequence of phases. Each phase built upon the outcomes of the previous one, creating a coherent trajectory from initial preparation to final dissemination. This structured

progression ensured not only academic rigor but also meaningful engagement with the local community and stakeholders.

Preparatory Phase

The preparatory phase represented the foundation of the collaboration at RU. It involved initial meetings between faculty members, Erasmus+ coordinators, and local stakeholders. The focus was on establishing institutional partnerships, defining roles and responsibilities, and co-designing the educational content.

Students from the Department of Mathematics were introduced to the principles of Service-Learning and trained in the basic concepts of sustainable energy access. Planning sessions with community representatives provided insights into local challenges, such as energy efficiency in schools and awareness gaps in renewable energy adoption. This groundwork created a shared understanding among all participants and ensured that subsequent activities would be both relevant and feasible.

First Implementation Phase

During this stage, interdisciplinary activities were organized with the explicit aim of combining academic learning with community impact.

Students engaged in theoretical sessions on renewable energy systems, followed by practical demonstrations of solar-powered technologies. Workshops encouraged participants to explore how solar energy could be adapted to everyday contexts, from household applications to larger community infrastructures.

A key feature of this phase was its emphasis on experiential learning. Students were tasked with small-scale projects—such as designing awareness posters, simulating energy consumption patterns, or conducting surveys—to directly connect classroom concepts with community realities. The cooperation among faculty, students, and external stakeholders fostered a dynamic learning environment that encouraged both creativity and civic responsibility.

Second Implementation Phase

The second implementation phase, held between June 30th and July 11th, 2025, expanded the scope of activities and deepened the engagement between academic and societal contexts.

This stage included exploratory sessions and interactive discussions focused on climate-conscious behavior, solar innovation, and sustainable community practices. Participatory formats such as group debates, role-playing scenarios, and problem-solving workshops were employed to adapt to the diverse profiles of students and stakeholders.

Particular attention was given to fostering critical thinking and reflective dialogue. The activities challenged students to not only learn about renewable energy but also to analyze its societal implications, including equity of access, long-term environmental impact, and policy relevance. Community engagement was reinforced through collaborative initiatives with local schools and NGOs, thus amplifying the reach of the project beyond the university environment.

Final Phase – Evaluation and Dissemination

The final phase of the project took place from July 28th to August 8th, 2025, and was dedicated to consolidating outcomes and disseminating results.

Evaluation sessions allowed faculty and students to reflect on the pedagogical effectiveness of the Service-Learning approach. Feedback was collected through questionnaires, group reflections, and stakeholder dialogues, ensuring a comprehensive assessment of both academic and community impact.

Dissemination activities included public workshops, presentations to local authorities, and academic seminars. These events highlighted innovative practices in sustainable energy education and promoted dialogue on the role of higher education institutions in addressing climate-related challenges.

Through these final activities, the project not only reinforced its immediate results but also created pathways for long-term sustainability. The partnership between UTCB and RU was further strengthened, laying the groundwork for future collaborative projects under the Erasmus+ framework and beyond.

RESULTS, IMPACT, AND DISCUSSION

The implementation of the Service-Learning initiative at the University of Ruse “Angel Kanchev” (RU) generated significant academic, social, and institutional outcomes. By combining rigorous educational content with practical community engagement, the project created a learning environment in which students were not only recipients of knowledge but also active contributors to social change. The results are best understood by examining their impact across multiple dimensions: student competencies, community involvement, institutional collaboration, and regional visibility.

In addition, the comparative analysis between the experiences at the Technical University of Civil Engineering Bucharest (UTCB) and RU provides valuable insights into the adaptability of Service-Learning across cultural and institutional contexts. These outcomes highlight the transformative potential of experiential pedagogies when aligned with sustainable development goals and supported by cross-border academic partnerships.

Student Competencies

One of the most tangible results of the project was the development of student competencies that extended beyond traditional academic skills. The Service-Learning framework provided students with opportunities to integrate theoretical knowledge with hands-on practice, thereby strengthening their learning outcomes across three main areas:

Technical Skills: Students acquired practical experience in renewable energy concepts, particularly solar technologies. They learned how to design small-scale solutions, interpret energy efficiency data, and simulate renewable energy applications using mathematical and engineering tools.

Critical and Analytical Thinking: Activities such as debates, reflective sessions, and project-based tasks challenged students to analyze energy issues from multiple perspectives, including technical feasibility, environmental sustainability, and social equity.

Civic Responsibility and Soft Skills: Through interaction with local stakeholders and schools, students developed communication, teamwork, and leadership abilities. More importantly, they cultivated a sense of civic responsibility by recognizing their role as agents of change in promoting sustainable energy practices.

These competencies illustrate the multidimensional benefits of Service-Learning, positioning students not only as learners but also as innovators and contributors to community well-being.

Community and Stakeholder Engagement

A defining feature of the Service-Learning project at the University of Ruse “Angel Kanchev” (RU) was its strong emphasis on community engagement. Unlike traditional academic projects that often remain confined to the classroom, this initiative extended into the local environment, actively involving schools, non-governmental organizations, and municipal stakeholders.

Schools and Educators. Local schools became valuable partners, serving as both beneficiaries and contributors to the project. Teachers collaborated with university staff to host awareness workshops on sustainable energy and environmental responsibility. These workshops provided schoolchildren with accessible explanations of solar energy concepts and practical demonstrations, thereby fostering early awareness of renewable energy solutions.

Non-Governmental Organizations (NGOs). Several NGOs in the Ruse region supported the project by sharing resources, co-organizing events, and facilitating connections with vulnerable community groups. Their involvement helped expand the reach of the activities, ensuring that the message of sustainability and renewable energy adoption reached diverse audiences.

Local Authorities and Civic Stakeholders. The municipality of Ruse expressed strong interest in the project's outcomes, particularly in relation to community awareness campaigns. Participation in dissemination events not only validated the project's relevance at the local policy level but also encouraged dialogue between academia and decision-makers on integrating renewable energy practices into municipal strategies.

Mutual Benefits. For the community, the project provided access to knowledge and demonstrations that would otherwise remain within academic settings. For the university, these interactions enriched the educational experience, ensuring that students could witness the societal relevance of their work and engage in authentic problem-solving.

The collaborative relationship between the university and the community strengthened mutual trust, creating the foundation for long-term partnerships. This dimension of the project highlights the power of Service-Learning to bridge the gap between academic expertise and societal needs, ultimately contributing to regional development and awareness of sustainable energy practices.

Institutional Partnerships and Academic Collaboration

The extension of the Service-Learning project to the University of Ruse "Angel Kanchev" (RU) significantly reinforced institutional partnerships and fostered academic collaboration between the participating universities. The cooperation between the Technical University of Civil Engineering Bucharest (UTCB) and RU served as a model of cross-border academic synergy within the Erasmus+ GIRLS framework.

Strengthening Bilateral Relations. The collaboration deepened the ties between the two universities, allowing faculty members to exchange expertise, pedagogical practices, and methodological approaches. Joint coordination of the project phases promoted a shared vision for sustainable education, while continuous dialogue ensured the coherence and adaptability of the activities to both institutional contexts.

Faculty Engagement. Academics from both UTCB and RU played a central role in guiding student activities, developing teaching materials, and facilitating reflective sessions. Their cooperation fostered a multidisciplinary approach, integrating mathematics, engineering, education, and social sciences into a cohesive learning experience. This interdisciplinary engagement highlighted the value of academic collaboration in addressing complex sustainability challenges.

Mobility and Knowledge Transfer. The Erasmus+ framework provided opportunities for mobility, enabling direct interaction between staff and students from both institutions. Such exchanges facilitated knowledge transfer, comparative reflection, and mutual enrichment. The joint implementation of activities in Ruse represented not only an extension of the project but also a demonstration of how mobility programs can serve as catalysts for educational innovation.

Institutional Benefits. For UTCB, the extension of the project validated the replicability of the Service-Learning model in different cultural and institutional settings. For RU, the collaboration brought visibility, access to innovative pedagogical practices, and integration into an international academic network. At a broader level, both institutions enhanced their profiles

as promoters of sustainability-oriented education, contributing to the European Higher Education Area's agenda on innovation and social responsibility.

This collaborative dimension of the project illustrates the transformative role of institutional partnerships in Service-Learning. Beyond individual student outcomes, the initiative fostered structural changes in the way universities perceive their mission—shifting from isolated academic institutions to active contributors to regional and global sustainability goals.

Regional Visibility and Dissemination

An essential outcome of the Service-Learning initiative at the University of Ruse “Angel Kanchev” (RU) was the increased visibility of the project at local, regional, and European levels. Dissemination activities ensured that the lessons learned and the innovative practices developed within the project extended beyond the immediate participants, reaching a broader academic and civic audience.

The project was promoted through a series of workshops, open events, and public presentations in Ruse. These activities engaged not only students and faculty but also members of the wider community, including local schools, NGOs, and municipal representatives. By showcasing student projects and solar energy demonstrations, the initiative attracted media attention and strengthened the perception of the university as an active contributor to regional sustainable development.

Results were presented in seminars and conferences hosted by RU, creating opportunities for dialogue among faculty, researchers, and students. The collaboration with UTCB also enabled joint dissemination in academic networks and thematic workshops, thereby enhancing the visibility of the project within the European Higher Education Area. The publication of outcomes in institutional repositories and specialized journals further amplified the project's academic reach.

As part of the Erasmus+ GIRLS project, the activities in Ruse were integrated into broader dissemination strategies across partner universities. The extension of the initiative to Bulgaria highlighted the replicability and transferability of the Service-Learning model, contributing to Erasmus+ priorities on innovation, sustainability, and cooperation in higher education.

The dissemination activities were not limited to presenting results but also aimed at creating long-term engagement. Dialogues with stakeholders fostered interest in developing follow-up initiatives, while media coverage and public outreach ensured that the project's messages on renewable energy and climate responsibility remained accessible to diverse audiences.

Through these efforts, the initiative achieved significant visibility, positioning both RU and UTCB as leaders in promoting Service-Learning as a vehicle for sustainability education and regional development.

CONCLUSION

The building of high-rise houses in high-risk earthquake zones is in a great demand in the modern world. So, damping bearings with low horizontal stiffness allow fulfilling this demand. Thus, application of non-traditional methods of seismic protection in high hazard earthquake areas is especially effective for building hospitals, which require long-term operations and storage centers for fragile items or antiques.

ACKNOWLEDGMENTS

This research is supported by Research Fund of the University of Ruse under the Project 2025-FNSE-03.

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