JST&M 8(2025), 61 – 66
DOI: 10.57131/jstm.2025.8.9

Case study

EDUCATING FOR SUSTAINABLE PLASTIC MANAGEMENT IN A CIRCULAR AND CLIMATE-NEUTRAL ECONOMY

Katrin Školnik Škrabe[1], Anja Bubik[1], Špela Dermol[2], Santiago Ferrándiz[3], Dana Perniu[4], Elena Cristina Rada[5], Anca Draghici[6]

[1]Faculty of Environmental Protection, Velenje, Slovenia,
[2]Dermol svetovanje d.o.o., Šmartno pri Litiji, Slovenia,
[3]Department of Mechanical and Materials Engineering, Valencia Polytechnic University, Spain,
[4]Faculty of Product Design and Environment, Transylvania University of Brasov, Romania,
[5]Department of Theoretical and Applied Sciences, University of Insubria, Varese, Italy,
[6]Faculty of Management in Production and Transportation, Politehnica University Timisoara, Romania

ABSTRACT

Plastic has become indispensable since its introduction in the late 1800s, valued for its flexibility, durability, and affordability. Global plastic production has grown exponentially, reaching 400.3 million metric tons in 2022, despite a temporary decline in early 2020 due to the Covid-19 pandemic. However, only 9% of all plastics ever produced have been recycled, with 60% accumulating in landfills or the environment, underscoring an urgent need for sustainable solutions to manage plastic waste.

To address this challenge, the Erasmus+ project EDU4PlasticCircular aims to bridge the gap in sustainable development education related to plastics. Through collaboration with six organizations across four countries, the initiative is developing a comprehensive training program targeting higher education staff, students, and industry professionals. Employing innovative methodologies and an open-access online platform, the program emphasizes the transition to a circular and climate-neutral economy with a focus on plastics. This paper outlines the project's objectives, methodologies, and anticipated outcomes, including equipping learners with the skills needed to advance sustainable practices. By fostering a deeper understanding of the circular economy, the initiative aims to promote sustainable practices and raise awareness about the critical issues surrounding plastics.

Keywords: plastics, plastic waste, circular and neutral economy, training programme, green skills/competences

Corresponding Author:
Anja Bubik
Faculty of Environmental Protection
Trg mladosti 7, 3320 Velenje, Slovenia
Tel.: +38638986424; fax: /
E-mail address: anja.bubik@fvo.si

1. INTRODUCTION

Plastic has become an indispensable material across various economic sectors and daily life, including construction, transportation, renewable energy, packaging, healthcare, clothing, and sports [1]. In 2022, global plastic production reached 400.3 million metric tons (Mt) [2]. However, an estimated 60% of all plastics produced have ended up in landfills or dispersed in the environment, while only 10% have been recycled. Approximately 30% of all plastics

ever produced are still in use [2,3]. This has led to plastic pollution emerging as a critical global environmental issue, largely driven by the widespread use of single-use plastics [4]. These products are typically designed for short lifespans and are often discarded within a year of production [4,5]. Single-use plastics, particularly plastic packaging, are a major concern. Globally, only 14% of plastic packaging is collected for recycling, and of that, just 5% retains its material value for reuse. The leakage of plastics into the environment (Figure 1), particularly into marine ecosystems, is a significant problem [6]. Plastic production not only harms the environment but also plays a significant role in driving climate change. In the European Union, plastic manufacturing generates approximately 13.4 million tonnes of CO_2 emissions annually, accounting for roughly 20% of the total emissions from the EU's chemicals industry [7,8].

Figure 1. Plastic litter on the Savinja riverbanks, Slovenia (Faculty of Environmental Protection)

To address this challenge, a shift towards a circular economy is being advocated, aiming to minimize plastic waste and environmental harm by considering every stage of the value chain, from product design to disposal. This approach promotes a sustainable, waste-reducing system and aligns with the European Green Deal, launched in December 2019 [9], which seeks to make the EU climate-neutral by 2050. The European Green Deal supports the transformation to a fair and competitive economy by integrating policies across various sectors, an approach endorsed by the European Council to tackle climate and environmental challenges [4,10].

Today, there is an urgent need to address this problem at the educational level as well. Raising awareness and integrating environmental education are important steps toward achieving the EU's Green Goals. Projects targeting various learners, including those in higher education institutions (HEIs), play a significant role in this effort and are important for today's society.

2. ABOUT THE EDU4PLASTICIRCULAR PROJECT

EDU4PlastiCircular - Education for Plastic in a Circular and Climate Neutral Economy - Preventing Waste Ending Up in the Environment (EDU4PlastiCircular) [11] is a

pioneering Erasmus+ initiative that aims to transform attitudes and behaviours toward plastic use through education. Bringing together six partners from four countries, this project is a significant milestone in addressing global plastic waste and its impact on achieving a circular and climate-neutral economy. By providing target groups across the EU with essential knowledge and skills, EDU4PlastiCircular is dedicated to advancing circular economy principles and fostering eco-responsible citizenship.

The lead partner of the project is Politehnica University Timisoara (Romania), with the other partners, including Valencia Polytechnic University (Spain), Transylvania University of Brasov (Romania), University of Insubria (Italy), Dermol Svetovanje d.o.o. (Slovenia), and the Faculty of Environmental Protection (Slovenia).

Figure 2. Logo of the EDU4PlastiCircular project

The project (Figure 2) aims to enhance green skills among educators and students in higher education institutions, as well as among managers and employees, with a focus on sustainable plastic practices within the framework of a circular economy. It provides a comprehensive overview of the plastics lifecycle, from production to recycling, to foster awareness and responsibility. By incorporating digital technologies and innovative pedagogies, the project adapts established methodologies in plastic circularity to various educational settings. It also promotes equitable access to educational opportunities through online and remote learning, allowing trainers to teach without geographic limitations.

In addition, the project also supports the EU's digital transformation by:

- Developing innovative training methods and frameworks based on best educational practices.
- Providing open-access training materials, an e-learning platform, and upskilling opportunities for at least 200 learners.

3. GREEN SKILLS IN A CIRCULAR, CLIMATE-NEUTRAL ECONOMY

A circular economy is a system in which the value of products, materials, and resources is maintained in the economy for as long as possible while minimizing waste generation. It encompasses all stages of the value chain – from production and consumption to repair, remanufacturing, waste management, and the utilization of secondary raw materials. This model seeks to establish a sustainable, low-carbon, resource-efficient, and competitive economy by circulating materials in a manner analogous to the reuse, recycling, and recovery of water [1]. A climate-neutral economy refers to an economic system where overall activities don't harm the climate, aiming to achieve net-zero greenhouse gas emissions.

For the transition to a circular economy, green skills are essential. They include the technical expertise, knowledge, values, and attitudes necessary for green jobs that support a sustainable economy, society, and environment. These skills play a critical role in various industries, businesses, and communities, helping to prevent climate change and pollution [12]. Moreover, green skills are vital for reducing greenhouse gases and fostering sustainability, particularly as many industries have adopted eco-friendly practices to cut emissions [12]. The development and improvement of such green skills within various educational projects are essential for

advancing environmental sustainability, economic competitiveness, and social development in the future.

4. EXPECTED RESULTS OF THE PROJECT

Firstly, an analysis of existing training programs, curricula, courses, and syllabi will be conducted. This will result in a report compiling best practices from all partner countries. Based on this analysis and a gap analysis survey to evaluate the usefulness and knowledge of various topics, learning content will be developed. The topics are divided into five chapters, each containing 4 to 6 subchapters, including:

- Introduction to the Plastic World
- Plastic Waste Management
- Plastic in Circular Economy & Climate Neutral Economy
- Innovation in the Plastic World
- Awareness of Plastic Waste Impact & Responsible Behaviour

To implement and advance the developed learning content, the project will focus on several key activities:

- Develop innovative training methods tailored for staff, students, managers, and employees at higher education institutions, which will be compiled into a comprehensive handbook.
- Creating and making accessible training materials through online and mobile platforms, including a digital library, e-learning content, and an e-learning platform.
- Assessing the effectiveness of the learning methods, materials, and online/mobile learning platform. This phase will result in a tested e-learning platform, the delivery of both online and live courses, and training for 200 pilot learners.
- Ensuring the long-term sustainability and impact of the EDU4PlastiCircular training program by formulating a sustainability plan, and a post-project business model, and establishing future collaborations with partners, remote work companies, or public bodies through signed agreements and letters of cooperation.

Figure 3. EDU4PlastiCircular project website: https://microplastics.today/

The project will pilot the e-learning platform by integrating five training modules and enrolling 200 adult learners from various target groups, including HEI teachers, students, managers, and employees. The platform's effectiveness and the quality of the courses will be evaluated through learner feedback, which will be used to refine the courses and ensure their seamless integration into HEI e-learning systems and open educational resources (OER) platforms. Additionally, the project will include two Learning, Teaching, and Training Activities (LTTA) to upskill trainers. These face-to-face training events will prepare a total of 28 trainers, equipping them with the skills needed for the successful delivery of the newly developed e-learning content. An overview of the project is also available on our official website (Figure 3).

5. CONCLUSION

The EDU4PlastiCircular project is perfectly aligned with the Council Recommendation on Learning for the Green Transition, which was adopted in June 2022. This project will provide training opportunities for learners of all ages, with a strong emphasis on developing green skills and competencies within higher education institutions The Council's Recommendation urges Member States to integrate sustainability into all aspects of education and training, emphasizing the need for climate and sustainability education across both formal education (for example, schools and higher education) and non-formal education (such as extra-curricular activities, and youth work). It serves as a key policy statement supporting the goals of the European Green Deal [9,13].

Beyond its policy alignment, the EDU4PlastiCircular project delivers significant benefits to its target groups by equipping them with essential skills and resources for sustainable practices. Through activities such as gap analysis, best practice collection, and the creation of innovative training methodologies, the project provides participants with valuable knowledge about green jobs, materials, and technologies. The development of learning content, a digital library, and an e-handbook ensures that these resources are accessible, reusable, and adaptable, thereby empowering learners and institutions to integrate sustainability into their operations and promote green careers. The project is particularly significant in the context of managing plastic waste and mitigating its environmental impact. Plastics, especially microplastics, are widespread pollutants that damage ecosystems, wildlife, and human health. By offering education and training to individuals in higher education institutions, as well as managers and employees, EDU4PlastiCircular promotes sustainable practices that reduce plastic use, enhance waste management, and support the circular economy. This education is vital for developing solutions to the plastic crisis, fostering innovating in eco-friendly materials, and raising awareness about responsible plastic use.

Acknowledgment

The work presented in this paper was co-funded by the EU Erasmus+ project EDU4PlastiCircular: "Education for Plastics in a Circular and Climate Neutral Economy - Preventing Waste from Ending Up in the Environment" (Erasmus+ 2023-1-RO01-KA220-HED-000166242). The content of this paper and any related communication reflect the views of the authors alone, and the European Commission cannot be held responsible for any use made of the information provided herein.

Conflicts of Interest

The authors declare no conflict of interest.

6. REFERENCES

[1] B. Mrowiec, Plastics in the circular economy (CE), *Environmental Protection and Natural Resources*, 29 (2018) 4, pp. 16-19 https://doi.org/10.2478/oszn-2018-0017

[2] Plastic Europe, Plastics Europe launches Plastics – the fast Facts 2023, [Online]. Available: https://plasticseurope.org/media/plastics-europe-launches-the-plastics-the-fast-facts-2023/ [07. 08. 2024]

[3] R. Geyer, J. R. Jambeck, K. L. Law, Production, use, and fate of all plastics ever made, *Science Advances*, 3 (2017) 7, e1700782, https://doi.org/10.1126/sciadv.1700782

[4] K. Syberg, M. B. Nielsen, L. P. Westergaard Clausen, G. Van Calster, A. Van Wezel, C. Rochman, A. A. Koelmans, R. Cronin, S. Pahl, S. F. Hansen, Regulation of plastic from a circular economy perspective, *Current Opinion in Green and Sustainable Chemistry*, 29 (2021), 100462,https://doi.org/10.1016/j.cogsc.2021.100462

[5] J. Pichtel, M. E. Simpson, *Microplastics: Behavior, fate, and remediation.* Globe Pequot Publishing Group Inc/Bloomsbury, 2023, pp. 416.

[6] S. King, K. E. S. Locock, A circular economy framework for plastics: A semi-systematic review, *Journal of Cleaner Production*, 364 (2022), 132503. https://doi.org/10.1016/j.jclepro.2022.132503

[7] European Environment Agency, Plastics, the circular economy and Europe's environment – A priority for action. EEA Report 18/2020. Copenhagen, Denmark, 2021, pp. 76. https://www.eea.europa.eu/en/analysis/publications/plastics-the-circular-economy-and.

[8] European Environment Agency, Plastics, [Online], Available: https://www.eea.europa.eu/en/topics/in-depth/plastics [07. 08. 2024].

[9] European Commission, The European Green Deal (COM/2019/640 final), Brussels, Belgium, 2019. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52019DC0640&qid=1725443003845

[10] European Council. European Green Deal. [Online], 2024, https://www.consilium europa.eu/en/policies/green-deal/#what [13. 08. 2024].

[11] Microplastics.Today: EDU4PlastiCircular Project 2023, [Online] https://microplastics.today/ [22.08. 2024].

[12] Z. Ibrahim, C.S. Lai, A.F. Zaime, M.F. Lee, N.M. Othman, Green's skills in the knowledge and attitude dimensions from the industrial perspective. *IOP Conference Series: Materials Science and Engineering*, 917 (2020), 012025. https://doi.org/10.1088/1757-899X/917/1/012025

[13] European Commission, European Education Area. Learning for the green transition and sustainable development. [Online], https://education.ec.europa.eu/focus-topics/green-education/learning-for-the-green-transition [13. 08. 2024].