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EXPERIMENTAL APPROACHES FOR CIRCULAR BIOECONOMY EDUCATION: INTEGRATING SUSTAINABLE BIOTECHNOLOGIES AND GREEN INNOVATION IN STUDENT TRAINING

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Abstract: This study aimed to promote scientific understanding and transversal competences among students through experimental sessions focused on sustainable biotechnologies and circular bioeconomy principles. The activities were part of the CFABVC center within the project entitled „PEO/302424/INstruire prin Stagii de Practică sau Internship-uri RElevante pentru JOBuri de calitate - INSPIRE JOB”, emphasizing the reduction of environmental impact by transforming biological resources and waste into value-added biodegradable materials. Three experimental sessions were designed to illustrate key concepts of green biotechnology: (1) reducing the environmental footprint of the seafood industry by valorizing chitosan from crustacean waste; (2) using *Lemna minor* (duckweed) to recover nutrients and reducing sugars from wastewater; and (3) producing biodegradable films from crustacean residues. The sessions involved hands-on laboratory activities, demonstration experiments, and interactive discussions. Student feedback was collected through questionnaires and analyzed quantitatively and qualitatively to assess the development of transversal competences and perception of scientific relevance. Data analysis revealed an increased level of student engagement and understanding of sustainability-related topics. Over 85% of participants reported enhanced awareness of the circular use of biological resources, while more than 75% indicated that the activities improved their problem-solving and teamwork skills. The experimental sessions effectively combined scientific inquiry with environmental education, fostering both technical and socio-professional competencies. The integration of experimental learning focused on circular bioeconomy topics contributes not only to environmental awareness but also to the development of key transversal competences. The CFABVC activities demonstrate the value of combining biotechnology, microbiology, and educational innovation as tools for science popularization and sustainable skill formation in higher education..

• Introduction

Numerous authors mentioned that is a **growing demand on the labour market for circular bioeconomy specialists** (Mendoza et al. 2019; Kaewhao et al. 2023; Pachés et al. 2025).

The project entitled "PEO/302424/INstruire prin Stagii de Practică sau Internship-uri RElevante pentru JOBuri de calitate - INSPIRE JOB" included practical activities in laboratories to create and develop such skills.

Material and method

Teams of up to five Bachelor and Master of Science students from various domains as Biochemistry, Physics, Biology, Applied Sciences in Criminalistics, Mathematics-Computer Science and Clinical Chemistry were selected during the second semester of the past academic year in a series of practical activities to learn about:

- 1)reducing the environmental footprint of the seafood industry by valorizing chitosan from crustacean waste;
- 2)using *Lemna minor* (duckweed) to recover nutrients and reducing sugars from wastewater
- 3)producing biodegradable films from crustacean residues.

The activity ended with a competition between lab teams, with cash prizes. Also, the participants were asked to complete feedback questionnaires, for optimizations during the next year.

• Results and discussions

Laboratory
activities

Competitions

Feedback
questionnaires



• Conclusions

The responses to feedback questionnaires included mentions that the participants better understood green and circular bioeconomy concepts through **practical approaches**.

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