PACKALL

PackAlliance:
European alliance for innovation training
& collaboration towards future packaging

R5.2 Report on the programme implementation

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Glossary of terms, abbreviations and acronyms

Abbreviation / Acronym / Term	Description
CE	Circular Economy
CHAINs	CHAllenges INnovation teams. Collaborative teams of students of the PackAlliance postgraduate programme to work on a specific industry challenge
PackAlliance Hubs	Physical places where the academia-industry collaboration within the project will take place
WP	Work Package

Partner shortname	
P1-Campus Iberus	Partner 1 - Campus Iberus (Spain)
P2-Ecoembes	Partner 2 - Ecoembes (Spain)
P3-AGH	Partner 3 - AGH University of Science and Technology (Poland)
P4-Synthos	Partner 4 - Synthos Group (Poland)
P5-TAMK	Partner 5 - TAMK Tampere University of Applied Sciences (Finland)
P6-Pyroll	Partner 6 - Pyroll Group (Finland)
P7-Proplast	Partner 7 - Consorzio per la promozione della cultura plastica - Proplast (Italy)
P8-UNISA	Partner 8 - Università degli Studi di Salerno (Italy)

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1. Introduction

This report is motivated by the implementation of the first pilot edition of the PackAlliance training course. After completion of the training by students, the whole course consisted of a first 5-month part composed by 4 thematic modules with a duration of 5 weeks per module. Although the whole course was offered through the same online learning platform (Moodle), each module was organized as an independent course, and learning strategies were adapted to the contents and competences to be developed by the students. Following the completion of the 5-month competence-based training course, students were grouped into teams and were asked to address specific challenges related to CE and plastic packaging within the framework of a module (CHAINs) that worked over a period of 2 months and under the guidance and supervision of academia and industrial mentors.

As each thematic module, as well as the CHAINs, were independently organized, the aim of this report is to provide an insight on the main aspects related to the training implementation. The main training methodologies and distributed materials are referenced as well as how the student assessment was carried out. The feedback received by students is also evaluated and the main contingencies and barriers encountered as listed and discussed for future improvement.

2. Analysis of the training implementation

2.1. Module 1: New Materials and Bio-Based Materials.

- **Brief introduction**

The module on new materials and bio-based materials review the issues related to the knowledge of the possibilities of using innovative materials, including biomaterials in the plastic packaging industry in the context of the development of the circular economy. The module was dived into two sections. The emphasis of the first section was on the significance of the most recent knowledge in the field of material innovation for solving cognitive and practical problems in the field of new materials and biobased materials in the context of development CE. The second section was presented with an entrepreneurial spirit, including the economic and management aspects.

- T**raining techniques**

  - Plenary class
  - Group work
  - Case-studies
  - Exercises
  - Quiz
  - Forum
  - Question and Answer

- **Summary of distributed materials**

  - Power point presentations
  - Video movies
  - Exercises
  - Reports
  - Quizzes
  - Articles

Programme:

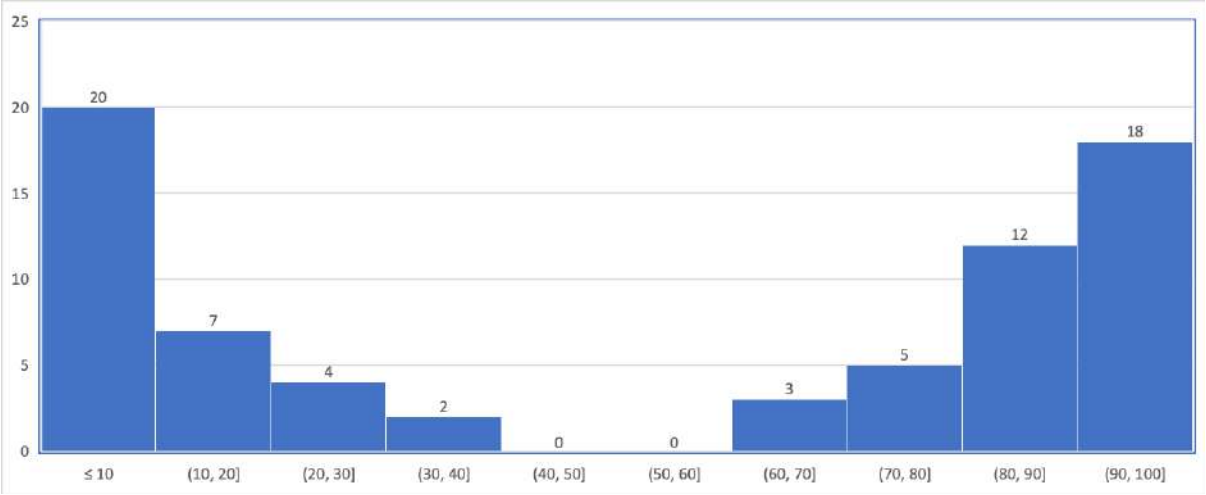
- 1 week
  - Lectures
  - Bioeconomy strategy and legal aspects of use of new materials and bio-based materials in packaging sector
  - Characteristics of the principles of circular economy
  - Practical Work
  - Advantages and disadvantages of the use of new materials and bio-based materials in the context of development of the CE (economical aspects)
  - Adapting bioeconomy strategies in enterprises in selected courtiers of EU Circular economy as a tool for promotion biomaterials in the field of packaging - policy challenges in different region

- 2 week
  - Lecture:
  - Characteristics of polymers as raw materials used in the production of packaging materials, including "new" and "bio" and production methods
  - Methods of recycling, recovery and reuse of bio-based materials
  - Practical Work:
  - Characteristics of biomaterials in plastic packaging sector (Online)
  - Certification and labelling – basic requirements and practice (Online)
  - Characteristics of new materials and biomaterials, and their types and use (Online)
  - Analysis of the rules of certification and labeling of biomaterials (Online)
- 3 week
  - Lecture:
  - Economic assessment and the value of bioplactic materials
  - Eco-innovations in the new materials and biobased materials technology related to the plastic packaging
  - Practical Work:
  - Analysis of the suitability of materials for various forms of post-consumer packaging waste management (Online)
  - Case study of chosen solutions on how to turn (bio)plastic wastes into assets for a company calculation (Online)
  - Willingness to pay (Online)
  - Resolve Model
- 4 week
  - Lecture:
  - Economic and Financial efficiency analysis of the new biomaterials in the plastic packaging industry
  - Practical Work:
  - Industrial Symbiosis (Online)
  - Triple Layers Business Model Canvas (Online)
  - Case study of financial efficiency analysis of the new biomaterials (Online)
- 5 week
  - Lecture:
  - Food packaging materials – regal requirements, properties of materials and their influence on the used for packaging purposes
  - Practical Work:
  - Analysis and evaluation of packaging materials used for the production of packaging, including for contact with food
  - Selection of appropriate packaging materials to the features and properties of the packed product (Online)

- **Participants evaluation and feedback**

	Name of the class	Total Points
25% of the Final Assessment – Asynchronous class	Bioeconomy strategy and legal aspects of use of new materials and bio-based materials in packaging sector	10
	Characteristics of the principles of circular economy	10
	Advantages and disadvantages of the use of new materials and bio-based materials in the context of development of the CE (economical aspects)	10
	Adapting bioeconomy strategies in enterprises in selected courtiers of EU	10
	Circular economy as a tool for promotion biomaterials in the field of packaging - policy challenges in different region	10
	Characteristics of polymers as raw materials used in the production of packaging materials, including "new" and "bio" and production methods	10
	Methods of recycling, recovery and reuse of bio-based materials	10
	Economic assessment and the value of bioplactic materials	10
	Resolve Model	10
	Economic and Financial efficiency analysis of the new biomaterials in the plastic packaging industry	10
	Food packaging materials – regal requirements, properties of materials and their influence on the used for packaging purposes	10
	Analysis and evaluation of packaging materials used for the production of packaging, including for contact with food	10

	Total	**120 points**
	Characteristics of biomaterials in plastic packaging sector	**10**
25% of the Final Assessment – Synchronous Class	**Certification and labelling – basic requirements and practice**	**10**
	Characteristics of new materials and biomaterials, and their types and use	**10**
	Analysis of the rules of certification and labeling of biomaterials	**10**
	Analysis of the suitability of materials for various forms of post-consumer packaging waste management	**10**
	Case study of chosen solutions on how to turn (bio)plastic wastes into assests for a company calculation	**10**
	Willingness to pay	**10**
	Industrial Symbiosis	**10**
	Triple Layers Business Model Canvas	**10**
50% of the final Assesement	**Case study of financial efficiency analysis of the new biomaterials**	**10**
	Selection of appropriate packaging materials to the features and properties of the packed product	**10**
	Total	**110 point**
	Eco-Innovation Project	**80 points**



- **Strengths, contingencies and barriers encountered**
  Strengths:
  - The development of the content was a collaborative effort involving specialists from various fields;
  - the module focuses on the technical, social, and economic aspects of new materials and biomaterials;

  Barriers:
  - demanding programme for students from diverse backgrounds;
  - online environment throughout the programme;

  Improvements:
  - the workload of the content should be reconsidered;
  - the group task should only occur in synchronous time, as it is difficult for students who do not know each other well to communicate in asynchronous time;
  - It is necessary to establish a single channel of communication between teachers and students.

- **General assessment of the impact on students' competences and recommendations for future editions.**

The general response of students to the module is either positive or neutral. Students regard knowledge, skills, and competence as valuable. According to student feedback, there are some organizational and meritorious aspects that can be enhanced for future editions. Because the module new materials and bio-based was the first module in the entire programme, there were some dropouts that made group work difficult to manage.

2.2. Module 2: Eco-Design and Novel Manufacturing Processing.

- **Brief introduction**

  The Module 2 was aimed to provide a broad applied knowledge about current and new manufacturing processes and packaging solutions of the packaging industries, especially for applications in the food sector, and a range of tools and techniques that can be applied to design and produce packaging for the sustainability and the transition towards Circular Economy models.
  It consisted of two courses:
  - Course 1: Novel Manufacturing Processing for Packaging Systems (3 ECTS; duration: 3 weeks, from November 8 to November 28, 2021)
  - Course 2: Packaging Design for Sustainability (2 ECTS; duration: 2 weeks, from November 29 to December 12, 2021)

- **Training techniques**

  Asynchronous video-lessons
  Synchronous lecture discussions
  Discussions in forum
  Auto-assessment quizzes
  Seminars
  Group works

- **Summary of distributed materials**
  The teaching materials developed for the course was published online on the Moodle platform made available by the project (https://elearning. campusiberus.es/course/view.php?id=9) and consisted of video-lessons, PowerPoint presentations, technical and informative videos of free access on you tube, pedagogical texts, technical and scientific publications (white papers, open access journal articles, book chapters and application guides) and self-assessment quizzes. These materials were listed in detail below.

  Course 1: Novel Manufacturing Processing for Packaging Systems

  Week1.
  - Video lessons on Extrusion processes
  - Video lessons on Industrial processes for flexible plastic packaging
  - Video lessons on production processes for rigid plastic packaging: Injection Molding, Blow Molding, Thermoforming and Foaming
  - Technical videos on Extrusion processes, Cast film extrusion and Film blowing
  - Technical videos on Injection Molding and Blow Molding
  - Book chapter on Polymer extrusion and Cast film extrusion
  - Book chapters and Application guides on Blow Molding, Thermoforming and Foaming
  - Self-Assessment Quizzes

  Week2.
  - Video lessons on Technologies for new packaging solutions: nanocomposites, active systems, recycled systems, biopolymers.
  - Video lessons on Manufacturing processes for new packaging solutions (coextrusion, extrusion coating, lamination)
  - Video lessons on Technological requirements of new sustainable packaging solutions
  - Technical videos on Manufacturing processes for new packaging solutions
  - Technical videos on Physical-mechanical testing of polymer films.

- Scientific publications (white papers, open access journal articles and book chapters) on Nanocomposites, Active systems, Bioplastics as food materials, Technologies for production of multilayer films, and Technological requirements of new sustainable packaging solutions
- Self-Assessment Quizzes

Week 3.
- Video lessons on Novel processing technologies: Advanced manufacturing processes and Additive manufacturing techniques
- Technical videos on Novel processing technologies
- Scientific publications on Novel processing technologies
- Video lessons on Innovation and sustainability in surface treatments, and on Sustainable printing technologies
- Technical videos on Innovation and sustainability in surface treatments, and on Sustainable printing technologies
- Technical and Scientific publications on Innovation and sustainability in surface treatments, and on Sustainable printing technologies
- Video lessons on Industry4.0 for new production technologies
- Pedagogical scripts on Industry4.0 for new production technologies
- Self-Assessment Quizzes

Course 2: Packaging Design for Sustainability

Week 4.
- Video lessons on Materials Eco-design
- Scientific publications (White papers, open access journal articles and book chapters) on Materials Eco-design
- EU legislation on Designing for the environment
- Self-Assessment Quizzes

Week 5.
- Video lessons on LCA
- Demo of the LCA software package SimaPro
- Tutorials of SimaPro
- Self-Assessment Quizzes

- **Participants evaluation and feedback**

The assessment of the participants' learning outcomes was performed through the grading of three different tasks:
- End-of-module quiz
- Project work in teams
- Forum Participation

The grading procedure and timing were detailed in a form published online in the Moodle platform of the course at its start (https://elearning.campusiberus.es/pluginfile.php/4980/mod_resource/content/6/Assessment%20of%20Module%202.pdf). The document is reproduced below.

		Points
25% of the Final Assessment – End-of-module Quiz	**Course 1. Novel Manufacturing Processing for Packaging Systems** • Production processes for flexible plastic packaging • Production processes for rigid plastic packaging: injection molding, blow molding, foaming • Technologies for new packaging solutions: nanocomposites, active systems, recycled systems, biopolymers • Manufacturing processes for new packaging solutions • Technological requirements of new sustainable packaging solutions • Novel processing technologies • Innovation and sustainability in surface treatments • Sustainable printing technologies • Industry 4.0 for new production technologies	**15**
	Course 2. Packaging Design for Sustainability • Material ECO design • Designing for the environment and the law • Production, supply chain management and logistic improvement • Design for minimization • Design for reuse, recycling and recovery • An evaluation of a product environmental impact: Life Cycle Analysis • How to perform an LCA	**10**
25% of the final Assessment – Forum Participation	**Participation in Forum Discussions**	**25**
50% of the final Assessment – Team Work	**Project: Proposal of an Innovative Sustainable Flexible Packaging Solution**	**50**
	Total	**100**

Minimum score to pass the module: 50 points.

Info on End-of-module Quiz (open from 10.12.2021 to 12.12.2021)

Total points you can earn: 25

Type of questions:
- Single select multiple choice questions, Multiple select multiple choice questions, True/False questions.

Grading:
- For each question, the points you can earn for each correct answer is specified. Incorrect answers will give 0 points.

Info on Discussion Forums (open from 8.11.2021 to 12.12.2021)

Total points you can earn: 25

Expectations:
- Starting from the "conversation starter" question, contribute to create a thread posting your comments/opinion/ideas on it. Anyway, you are not limited to these topics. If you're interested in something else, start a new thread and see what your co-learners have to say.
- Plan on participating in the discussions at least twice a week, so you can provide your own answers and respond to others'.

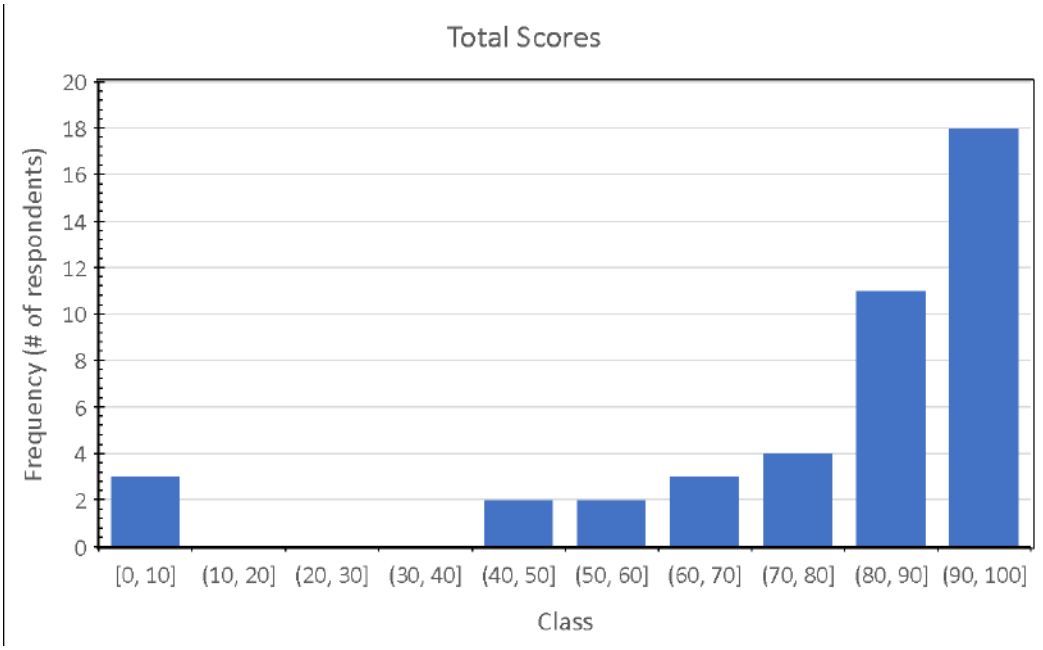
Ideas for Posts for Discussion Forums
- Postings about anything relevant to the readings and in-class discussion for that week.
- Ideas of your own that the reading has inspired
- Examples of how principles or guidelines are violated or followed well.
- Questions or comments on related issues (e.g. changes due to adoption of some technology)
- Supplemental discussion of a part of the reading that you believe you fully understand
- Content in the readings that you do not understand, or you think is confusing
- Content in the readings you think is right

Criteria for Final Proposal Assessment (open from 8.11.2021 to 12.12.2021)

Total points you can earn: 50

Assessment criteria	Points
Content of the presentation	20
Clarity of the presentation	15
Strength of the idea	15
Total	**50**

The results obtained by the students are illustrated in the histograms below.


Total Scores
Frequency (# of respondents)
20
18
16
14
12
10
8
6
4
2
0
[0, 10]
(10, 20]
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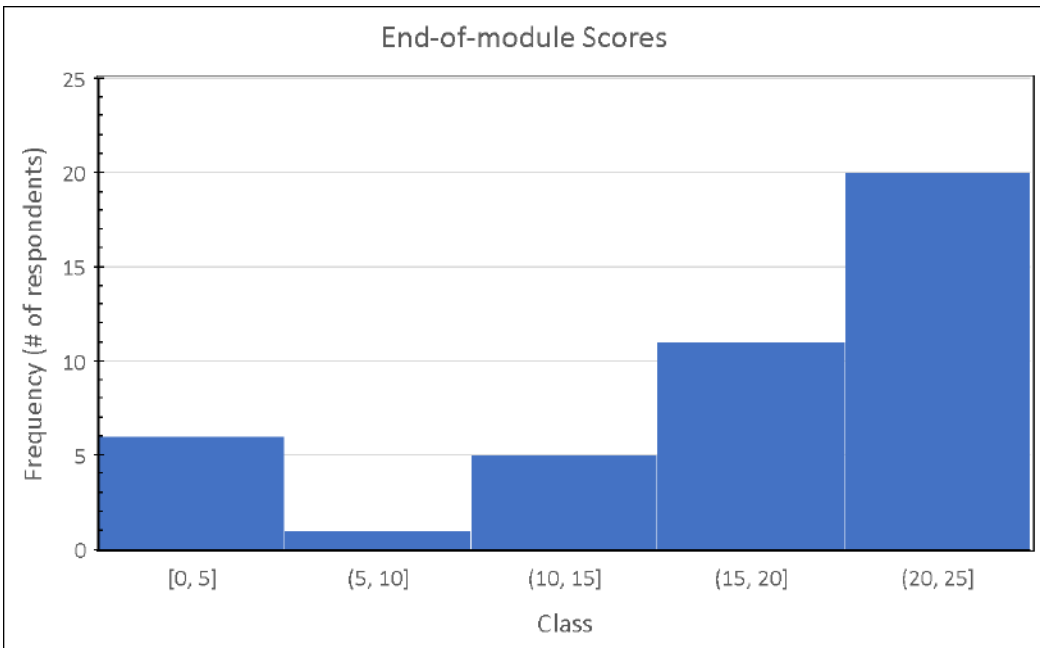
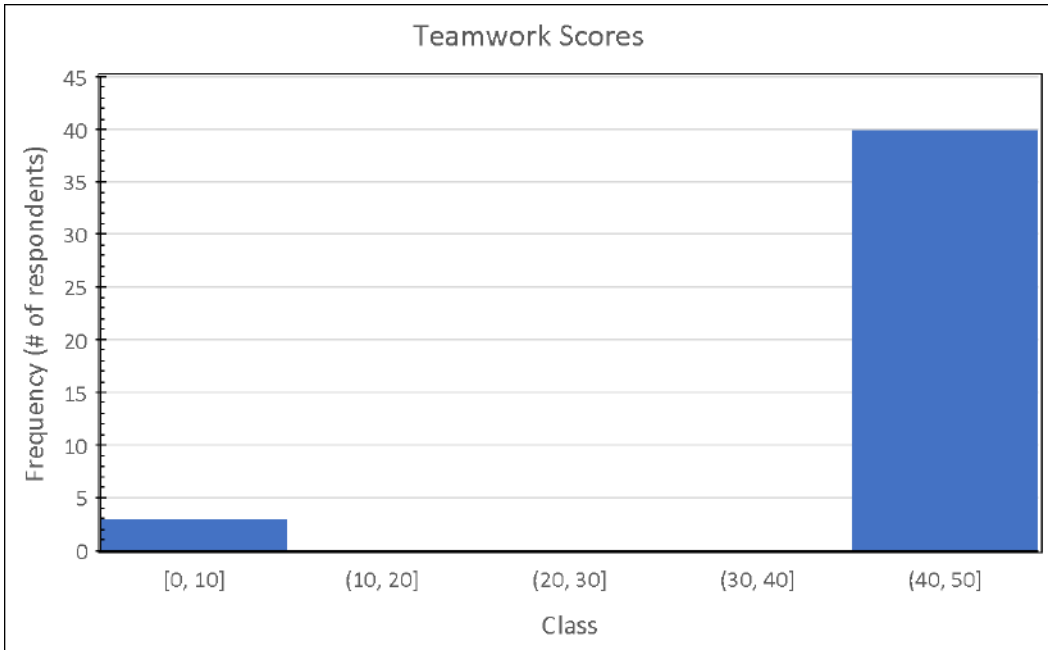
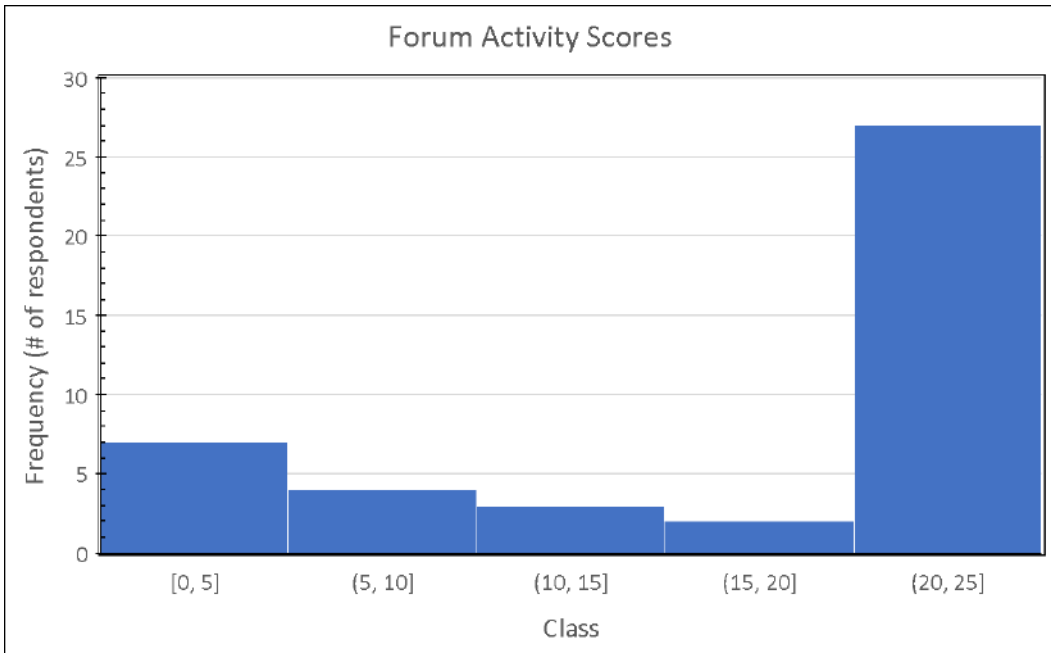
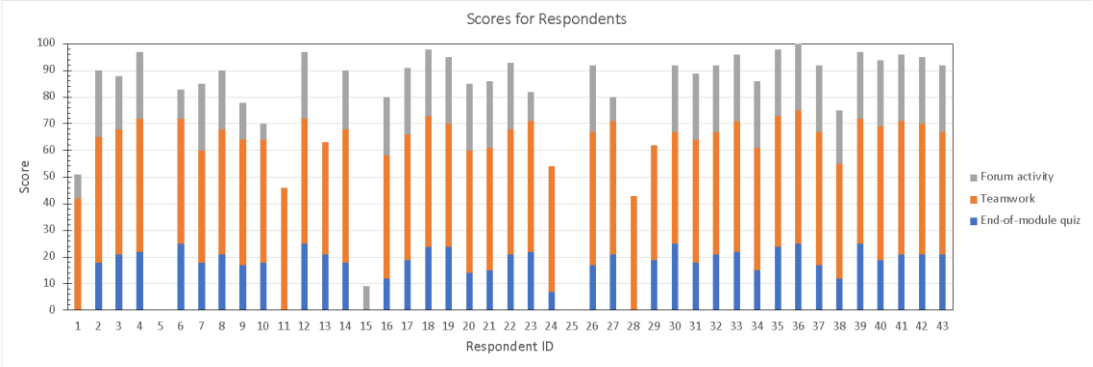
(50, 60]
(60, 70]
(70, 80]
(80, 90]
(90, 100]
Class


End-of-module Scores
Frequency (# of respondents)
25
20
15
10
5
0
[0, 5]
(5, 10]
(10, 15]
(15, 20]
(20, 25]
Class


Teamwork Scores
Frequency (# of respondents)
45
40
35
30
25
20
15
10
5
0
[0, 10]
(10, 20]
(20, 30]
(30, 40]
(40, 50]
Class


Forum Activity Scores
Frequency (# of respondents)
30
25
20
15
10
5
0
[0, 5]
(5, 10]
(10, 15]
(15, 20]
(20, 25]
Class



- **Strengths, contingencies and barriers encountered**

  Strengths:
  - In-depth and up-to-date specialist training in the fields of: innovative and sustainable packaging production technologies; eco-design; Life Cycle Assessment.
  - Synergic cooperation between Unisa and Proplast, which focused the program on companies' current needs.
  - The "student center approach" of the program, which supports students in building their career path according to their personal needs and expectations.

  Barriers encountered:
  - Synchronous lessons timetable was not always fitted well with other commitments of the participants.
  - Quite a busy and demanding program, which leaves reduced time for free thinking, reflection and creativity from the students.
  - Some training materials were too thorough for students with basic technical background.
  - Limited activity for interaction between students and teaching staff.

  Improvements:
  - Improvements should regard the following aspects: workload appropriateness, time scheduling, manageability by students of training materials, redesign of some tasks and activities for promoting students-teaching staff interaction, availability of more videos or practical examples.
  - Addition of "getting to know each other" session, to encourage comments and facilitate group works in the e-learning environment.
  - More detailed feedback on the grade of the assignments (not only the scores, but for some assessments - e.g., team works - also comments to allow opportunities for improvement to the students).

- **General assessment of the impact on students' competences and recommendations for future editions.**

  The course allowed students to gain a major awareness about food packaging technologies and their impact on the environment. Indeed, the course was really effective in the improvement of competences in the field of food packaging production techniques with a particular regard to the correct choice of materials, new and advanced manufacturing technologies and the relative strategies to evaluate packaging sustainability in the food sector.

  For the future editions, a main recommendation is to perform a better organization of the activities, with a particular regard to the workload and to the synchronous activities.

Module 3: Residue Management and Valorization.

- **Brief introduction to the module**

The development of sustainable waste management strategies has become a major concern worldwide. The Residue Management and Valorization module addressed issues related to recovery and recycling of plastic waste materials while paving the way towards CE.

The module was divided in three courses: Logistics and Sorting (2 ECTS), Recycling Systems & novel business models for the second life of residues (2 ECTS) and Economic, Environmental and Legislative aspects of plastic waste (1 ECTS). The three courses were conducted sequentially within a five-week period, starting on December 13, 2021 and ending on February 6, 2022.

The Module 3 was aimed at providing fundamental knowledge regarding residue management of polymeric packaging in the context of CE. The course also provided insights into the logistics of plastic packaging waste, and the methods to optimize sorting and recycling by mechanical or chemical means. Furthermore, novel business models facilitating the second life of residues were presented, as well as the many economic, environmental and legislative constraints within the EU framework.

- T**raining techniques**

The Residue Management and Valorisation course consisted of both synchronous and asynchronous contents addressed to provide assets for understanding the boundary conditions affecting the management of residues as well as to allowing students to deepen their knowledge of management and valorisation of polymer packaging materials in the context of the development of the circular economy. Asynchronous materials were offered as itinerary self-learning lessons containing contents, pre-recorded video lessons, auto-assessment quizzes and case studies. In parallel, forum discussions were encouraged in order to promote group participation and interaction. Synchronous materials consisted of 5 synchronous lecture discussions (one per week) in which specific topics were addressed in the form of seminars, case studies and group discussions.

- **Summary of distributed materials**

For the Residue Management and Valorisation course, the teaching materials were published online on the Moodle platform made available by the project (https://elearning.campusiberus.es/course/view.php?id=9). The contents consisted of written contents, video-lessons, technical and informative videos and documents, scientific publications, self-assessment quizzes and essay activities. All these materials are listed hereafter:

Course 1: Novel Manufacturing Processing for Packaging Systems

Week 1
Lessons:
Introduction to polymer materials and polymer processing.
- Polymeric materials
- Processing of plastics
- Effects of processing on thermoplastics
- Need of sorting plastic
- Reprocessing of thermoplastic recyclates

Seminar: Current industry position on plastic production and recycling

Essay activities and self-assessment quizzes.

Week 2
Lessons:
Residue management.
- Municipal solid waste. Data analysis, prediction and optimization.
- Plastics value and lifetime

Seminar: Management methods for municipal solid waste
Essay Activities and Self-Assessment Quizzes.

Week 3
Lessons:
Optimization of plastics recycling
- Reduction of sorting processes
- Upcycling of plastic waste by blending
- Increasing the recycling rate.

Mechanical recycling of packaging waste.
- Structure of recycling chains for packaging wastes
- Technologies of the pre-enrichment level.
- Refinement

Seminar: Secondary plastic products. Examples and market trends.
Task.

Week 4
Lessons:
Chemical routes for recycling.
- Dissolving, catalytic, and thermochemical technologies.
- Depolymerization and leaching.
- Thermochemical recycling of plastics waste.

Seminar: Future prospects of chemical recycling.
Essay Activities and Self-Assessment Quizzes.

Week 5
Lessons:
Chemical routes for recycling.
- Dissolving, catalytic, and thermochemical technologies.
- Depolymerization and leaching.
- Thermochemical recycling of plastics waste.

Seminar: Future prospects of chemical recycling.
Essay Activities and Self-Assessment Quizzes.

- **Participants evaluation and feedback.**

The assessment of the participants' learning outcomes was performed through the grading of different tasks:

- End-of-lesson tests (29 points): Single select multiple choice questions, Multiple select multiple choice questions, True/False questions. The points earned for each correct answer was specified. Incorrect answers gave 0 points.

- Short-essay activities (33 points): The points earned for each essay were specified in the activity. The grade was assigned considering the evaluation of the contents and of the clarity of each response.
- Task assignments: The points earned for each task was specified for each activity. The grade was assigned considering the quality of the contents and the clarity of the presentation.
- After session and Forum Participation (15 points): Students were expected to: create a thread by posting their comments/opinion/ideas on a "conversation starter" question; plan on participating in the discussions at least twice a week.

The grading procedure and timing were detailed in a form published online in the Module platform of the course at its start (https://elearning.campusiberus.es/pluginfile.php/5483/mod_resource/content/2/Assessment%20of%20Module%203.pdf). The document is reproduced below.

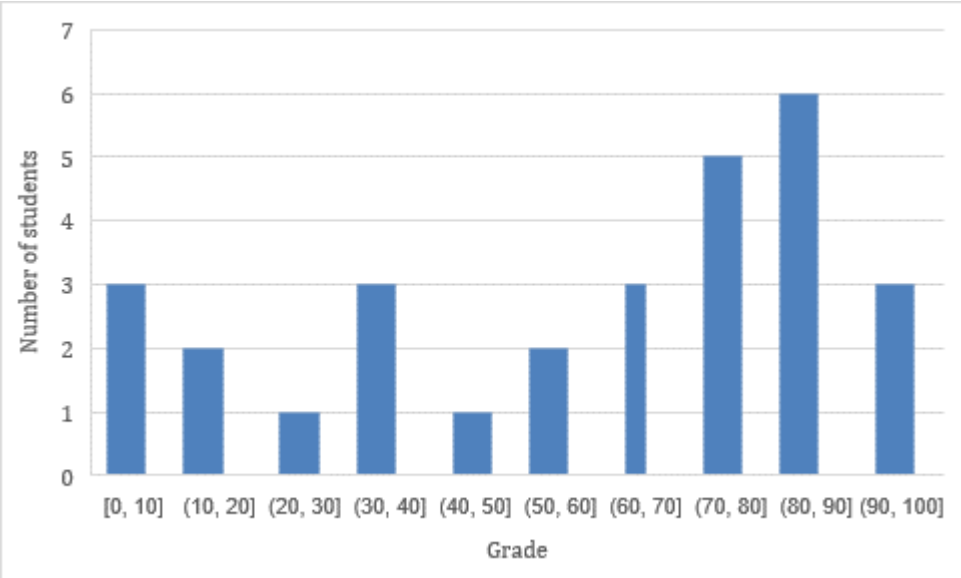
The courses had individual evaluation schemes based on the course assessment criteria presented for the participants in advance. In the course on Residue Management and Valorisation, the overall grading was 100. The minimum score required to pass the module was 50 points.

Table. Assessment of module 3.

Lesson	Week	Activity	Score
1. Logistics, sorting & recycling systems			**40**
1.1. Introduction to polymer materials and polymer processing	**1**	Short questions / Effects of processing on thermoplastics. Practice test: Compatibility of plastics. Lesson end test.	6 4 10
1.2. Residue management **1.2.1. Introduction to RM** **1.2.2. Waste collection** **1.2.3. Sorting plants**	**2**	Task EXPRA Alliance Test / Waste collection Test / Sorting plants After-session discussion/test	8 5 5 2
2. Recycling Systems & novel business models for the second life of residues			**40**
2.1 Optimisation of plastics recycling **2.2. Mechanical recycling** **2.3 Secondary plastic products. Examples and market trends**	**3**	Task / Secondary plastic products After-session discussion	15 5
2.4. Chemical routes for recycling. - **Depolymerisation and leaching** - **Thermochemical processes** - **Energy recovery**	**4**	Short essay / Solvent purification Short essay / Chemical depolymerisation Short- essay / Fischer Tropsch reaction Short- essay / Water-Shift reaction Short- essay / Three-Way-Catalyst Short- essay / Information on dioxins After-session discussion	2 2 2 2 2 2 8
3. Economic, environmental and legislative aspects of plastic waste			**20**
3.1 Economic analysis of plastic waste handling		Short-essay / Evaluation question 1 Short-essay / Evaluation question 2 Short-essay / Evaluation question 3	1.5 1.5 1.5

3.2. Environmental impacts of plastic waste handling	**5**	Short-essay / Find information Short-essay / Eutrophication Short-essay / Acidification Short-essay / Global warming Short-essay / Photochemical ozone Short-essay / Think about results Short-essay / Final conclusion	1.5 1.5 1.5 1.5 1.5 1.5 1.5
3.3. European Union's plastic strategy		Lesson end test	5

The overall grade distribution of the module Residue Management and Valorisation is presented in the following histogram.



In the three courses the grades correlated well with the activity of the course. Some students experienced some difficulties in catching up with the activities and deadlines of the course. As the course was offered as a part-time activity, extra time was given to finish the activities.

- **Strengths, contingencies and barriers encountered**.

Strengths:

- The training contents were positively evaluated by the students as they allowed upgrading their skills regarding the management of plastic residues.
- The cooperation between Campus Iberus experts and Ecoembes in the design and preparation of training contents produced a sound module learning itinerary.

Contingencies:

- Some students could not participate in the synchronous activities due to their commitment in other activities. The online sessions were recorded in order to attenuate this problem.

- Students generally stated the amount of assignments was too high. Some adjustments were made during the course, when possible, in order to reduce the work load.
- Some students could not deliver their assignments in due time. In those cases, extra time was provided for completing the module courses. However, this was considered when evaluating their activities and penalties were included in the rates.

Barriers:

- Some students that could not catch up with the activities demanded several extensions for the activity deadlines. In some cases, this was likely due to the different nature of the assignments in the different modules. This was solved on a case-per-case basis but should be addressed holistically in next editions.
- Lack of participation in forums and discussion sessions from certain participants denoted the need for promoting motivation of students.

- **General assessment of the impact on students' competences and recommendations for future editions.**

The assessment of the impact of module 3 (Residue Management and Valorisation) on the student's competences is positive in overall terms. Students provided a positive feedback of the contents of the module, which allowed them to increase consciousness regarding the complexity of the management of plastic residues, and how this fact affects the whole value chain. From their feedback, as well as from the contingencies encountered during the course's implementation, it can be concluded that some improvements are necessary for next editions. These improvements pertain workload, redesign of some training contents to increase interactions between students and lecturers as well as within students, and a better scheduling for the assignment deadlines. Also, the feedback to students could be improved in terms of including comments regarding their performance. This was done in some activities but not in all cases.

In all, a few students expressed their awareness about the acquired knowledge and the usefulness of the developed skills in a professional framework. The participation in group discussions and forums should be promoted, as it contributed to improve their critical thinking and communication competences.

2.3. Module 4: Citizen and Consumer Engagement.

- **Introduction to the module**

End-users are recognized as key players of the circular economy whereas their role has remained invisible. Instead of seeing citizens and consumers as passive adopters of the CE principles and innovations, they should be seen as actors whose active involvement is needed for ensuring the best circular development. The module Citizen and Consumer Engagement aimed at changing the understanding of end-users and providing tools to engage end-users in circularity.

The module was divided in two courses: Citizen Engagement, 2 ECTS, and Consumer Engagement, 3 ECTS. The module made the division between two roles of end-users: as citizens and as consumers. The Citizen Engagement course identified end-users as members of society whose circular behaviour is impacted e.g., by laws, regulations, and policies, and whose engagement may be linked e.g., to civil activism. The Consumer Engagement course identified end-users as actors in businesses whose behaviour e.g., companies try to impact.

Both courses were conducted simultaneously in a five-week period. The Citizen Engagement course was based on individual assignments and a group assignment that took the form of a role play that was cross-cutting the whole five-week period. The Consumer Engagement course was based on topical lectures, individual and group assignments together with a consumer engagement innovation project at the end of the five-week course.

- T**raining techniques**

In the Citizen Engagement course, individual and group assignments were used to facilitate students learning on the connections of the principles of public participation and furthering circular economy in society. Introductory materials were offered through pre-recorded lectures (Introduction to participation) and online lectures, which were recorded and available for students after the online sessions. The following methods were used to engage students in individual study between online sessions: fill in task in Moodle (concepts of the CE) and media follow-up followed by discussion on Moodle discussion forum (on examples of arranging citizen participation in Circular Economy). All the contents of the course were interconnected through a role play, in which the idea was to simulate stakeholder's thinking and engagement. The role play proceeded through weekly group tasks which required information seeking (opinion text, SWOT, campaign sketch). The idea of the tasks was to promote internalization of the stakeholder's viewpoints and arguments, to familiarize the students with various kinds of participatory campaign strategies and to plan argumentation for the final panel discussion. Groups received feedback of each task. Each part also included theory with online lectures, supported by group discussions. Finally, groups reflected, what they had learnt through the role play.

In the Consumer Engagement course, for example, joint discussions in small groups, ideating together, analysing industry expert interviews, and analysing one's own consumer behaviour, were used as the activating learning methods. Each unit also included a theory part with online lectures, supported by group discussions and individual tasks related to the theory content. For both courses, the students were requested to keep a learning log to structure and reflect their learning throughout the courses.

- **Summary of distributed materials.**

Citizen Engagement
For the course Citizen Engagement, the following contact meetings were available for the students:

- **Meeting 1: Principles of Participation** The aim of the meeting was to give an introduction on the principles of public participation in furthering circular economy in society. It also introduced the case used in the role play “Update of EU Framework directive of Waste Hierarchy to include chemical recycling of plastics.” Students were introduced to the role play process and the Role Play Handbook describing the case, roles, and the process.
  Materials:
  Power Point:Citizen Engagement in Circular Economy of Plastics
  PlayBook for the Role Play = Script with Activities

  Self-study materials and activities on Circular Economy and Society
  Consisted of a video lecture on the relationship of Circular Economy and Society and an online fill-in task about the concepts of circular economy. Following additional reading recommendations related to the activities included Circular Economy glossary

- Circular Economy Schools of Thought
- Finnish Roadmap to Circular Economy (Especially pages 41–53)

In addition, a Q&A Forum on the CE Concepts was provided.

- **Meeting 2: Applying Public Participation in Plastic Packaging Policies**
  The meeting started by checking the students' assignments and were followed by an introductory lecture and group discussion. The main aim was to connect public participation and furthering circular economy on practical level. The introductory lecture gave an example of the diverse connections of decision-making, circular economy, and society by taking deeper a look at the substance of the case study i.e., chemical recycling of plastics.
  Lecture materials: PowerPoint slides: the topic of the role play Case: Chemical recycling

  Self-study materials and activities: Students were given an individual media follow-up task and a group activity related to the role play: SWOT analysis on Chemical Recycling of Plastics from the stakeholder's perspective and were provided with a template for the SWOT
  Additional reading recommendations supporting this meeting were given:
  - Citizen videos of recycling

- **Meeting 3: Applying Participation and Engagement in CE**
  The purpose of the meeting was to relate the cases students had found in media with principles the of participation and discuss the role of citizen engagement practices in the circular economy of plastics. The main material of the class was compiled by students through the media follow-up activity and the SWOT analyses. The class activities involved discussions of connecting the students' media follow-up cases with the principles of public participation and circular economy. SWOT analyses were used to go deeper to the role and understand the inevitable contradictions in the decision-making process. The lecture "Understanding controversies and conflicts" was used as a tool to take the results of SWOT analyses to a more conceptual and general level

  Materials PowerPoint slides: Understanding controversies and conflicts

  Self-study materials and activities: Group activities in the role play 1) Sketching a campaign to influence citizens and/or decision makers from the stakeholder group's perspective; 2) Preparing a speech and comments for the panel discussion. All student groups' previous submissions and teacher's comments constructed the materials for these activities.
  - PlayBook for the Role Play = Script with Activities

- **Meeting 5: Role Play: The panel discussion**
  The purpose of the meeting was to simulate the authority hearing for different stakeholders by a panel discussion. There students playing distinct roles in the role play could contribute, and argument and bring up their views as "stakeholder representatives" for the authority making the decision. The activities consisted of finalizing the arguments and questions (group work), panel discussion (teacher as a chairperson) and reflection phases during the lesson. The materials of this activity constructed of all the previous activities and materials of this course.

  Self-study activity: Each stakeholder group was asked to submit a reflection on what they had learned from the role play, focusing on what they had learned from the other groups.

- PlayBook for the Role Play = Script with Activities

Consumer Engagement

For the course Consumer Engagement, the following theory lectures were available for the students:

- **Lecture 1: Consumer behaviour in circularity**
  The lecture presented outcomes of recent research regarding circularity and plastic packaging. Key points of this material were presented and discussed during the contact learning day.
  Following additional reading recommendations related to this lecture were given:
  - Plastics - the Facts 2020 by PlasticsEurope. An analysis of European plastics production, demand, and waste.
  - Mintel global consumer trends

- **Lecture 2: Consumer communication and engagement to circularity**
  In this lecture, diverse ways to communicate circular economy actions, and how communication is used to engage consumers to circularity were presented through 4 case studies. The selected examples covered different sectors including circular plastics packaging.

  Following additional reading recommendations related to this lecture were given:
  - Case 1: Norway - Circularity Gap Reporting Initiative
  - Case 2: Marketing Approaches for a Circular Economy: Using Design Frameworks to Interpret Online Communications
  - Case 3: Can I Recycle This. Final Report
  - Case 4:Quantis_LOreal_Cosmetic Packaging Claims Guidelines

- **Lecture 3: Value creation and circularity**
  The lecture introduced the basic concepts of value creation, how they are related to business modelling and provided examples regarding consumers and plastic packaging circularity.

  Following additional reading recommendations related to this lecture were given:
  - Reuse book of Ellen MacArthur foundation: Reuse - Rethinking packaging

- **Lecture 4: Lean customer development and Innovation project guidance**
  The lecture material presented the idea and core steps of lean customer development method.

  In addition to the theory lectures, following tasks (Task 0-task 7) were available for the students in Moodle platform to support the learning of the course main contents
  - **Task 0 Learning log**
    Reflection is the activity of structuring and learning from what has happened. Based on the experience, information is accumulated that can be structured and new perspectives can be found. Reflection is a particularly useful way - and often a prerequisite - for individual learning and action development.
    In this task the students were advised to post a chapter every week and make a video podcast at the end, structured by the following questions:
    - What were your key learnings about the topics of Citizen engagement and Consumer engagement this week?
    - What new thoughts & ideas these topics raised?
    - What would be your advice to the plastic packaging industry?

- **Task 1 I as a consumer**
  As the course studies consumer behaviour, it is good to start by studying oneself as a consumer, as every one of us is a consumer.
  In Task 1A. Students were asked to answer to the poll questions that relate to their personal behaviour as a consumer.
  In task 1B. The students were asked after answering the poll to make a mind map about themselves as a consumer of plastic packaging.

- **Task 2 Getting to know future consumers**
  To understand consumer engagement practices, it is important to understand who the consumers are. Students have already studied themselves as consumers in Task 1 and this task extended the perspective towards the future. Are the consumers the same or different in the future? As there is no straightforward correct answer, this task gets the students to think for themselves what the critical changes are taking place in consumer behaviour in the future.
  In this task the students were asked to study future consumers by filling in a future consumer template together in groups of few students.

- **Task 3 How does plastic packaging engage you to circularity?**
  By observing the environment (supermarket, home, internet, other) and available plastic packaging solution, the students will get a hands-on understanding of the current state of engagement methods in use and relate the theory into practice in a concrete way.
  In this task the students were asked to choose an example of plastic packaging (from home, take a picture in a store, Google, other) that they think communicates well with the consumer or engages the consumer effectively to circularity. The students were asked to post their 'Engagement to circularity' reflection (on a given template) of on-pack communication and engagement to circularity to the dedicated Moodle discussion forum.

- **Task 4 Group discussion: Engagement to circularity**
  The purpose of this task was to share the learnings from Task 3 by discussing them through with other students. This is beneficial both in reflecting one's own learnings as well as in learning new viewpoints from other students. As the groups were international, the students got a chance to compare communication and engagement practices in the different countries with the help of this exercise. Students were asked to compile their observations on one PowerPoint slide. Following questions were provided to help to structure the discussion:
  - Pay attention to the similarities and differences in your consumer behaviour, especially regarding labelling and claims stated by the manufacturer
  - In your opinion, what are the possible advantages and disadvantages of labels and claims?
  - Is circularity of the packaging visible or credibly expressed in the packages you studied?
  - To what kind of consumption do the labels and claims on plastic packaging guide you?
  - Based on these examples, did the packaging communication engage you to circularity? Why/why not?

- **Task 5 Circularity at different steps of value chain**
  This task provided the students with the opportunity to hear the voice of the different players in the circular plastic packaging value chain through a series of recorded expert interviews. The

interviews were 10 min to 15 min “vodcast” type insights where the interviewees were asked to answer a set of 5 to 10 questions relevant for the course content and their topical expertise. The recorded interviews made it possible for the students to select the time of watching that suited their weekly schedule, despite the different time zones and working times, to maximize the reach and impact. Further, this approach gave the interviewers the possibility to select the desired interviewees regardless of their availability at a specific day of contact learning session, and to prepare high quality edited and subtitled materials for the students.

The students were asked to listen to four industry expert interview recordings and to think about their position in the value chain, and how they take the consumer into account. Students were especially asked to think about aspects like circularity, communication, and value creation, and answer the questionnaire in Forms.
The questions in the Forms were the following:

- In your opinion how strongly is the consumer taken into focus?
- How is the consumer engaged to circularity?
- What are the methods of consumer communication and engagement?
- If you think of yourself as a consumer, what is your impression, and would you improve something in engagement to circularity? If yes, what actions?
- In your opinion how well is the circularity value created to stakeholders?
- What players in the value chain get and create new circularity value and how?
- What challenges there may be in creating value?
- What would be the value for you as a consumer?
- What other comments do you have?

- **Task 6 Discovering consumer value of reusable packages (Bonus task for active students)**
  This task motivated the students to read relevant literature on the course topic of reusable packages and analyse its content critically through identifying the benefits and challenges and reflecting them to one's own thinking. Further the task motivated to also explore co-students’ opinions on the same topic and commenting on those to practice peer-review.
  The students were asked to familiarize with the material “Reuse – Rethinking Packaging” by Ellen MacArthur Foundation, and do the following steps:
  A. Study the benefits and challenges of reuse models.
  B. Make a benefits element analysis of a selected inspiring reuse case.
  C. Peer review. Read two other answers of your fellow students and reflect their findings with your own.

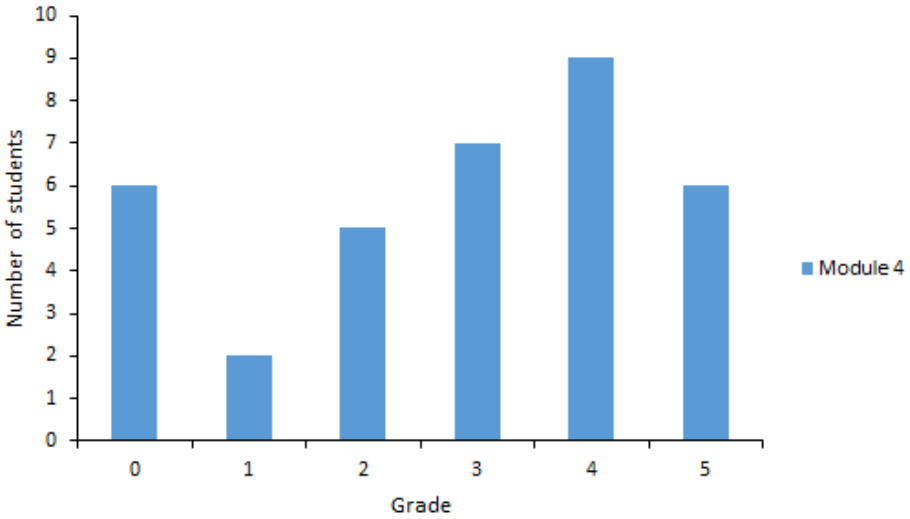
- **Task 7 Innovation project**
  This task taught the students the principles and steps of an innovation project that they will later need in a wider CHAINs challenge. The topic of this small innovation project made in groups of 5 students was selected by the students themselves based on their own interests and preferences. The fast 2-week sprint type innovation project will show the students that there are distinct levels of innovations projects, and that the depth of analysis needs to be set accordingly.

- **Participants evaluation and feedback**

Both the courses had individual evaluation schemes based on the course assessment criteria presented for the participants in advance. The courses were assessed based on the categories of knowing, acting, and being with pass/fail, or by grades of 1–2 (satisfactory; limited professional skills), 3–4 (good; applied professional skills), and 5 (excellent; creative, and developing professional skills).
In the course Citizen Engagement, the grading was as follows, giving total of 25 points.
Individual tasks
Circular economy concepts 1–3 p (compulsory task)
Starting discussion in media follow up 1–3 p (compulsory task)
Activity points on commenting media follow-up 0–3 p
Group tasks
Participation in role play 0–16 p. Each role play task 0–3 points, group reflection 0–2 points, self-reflection 0–2 points.

For the course Consumer Engagement, the grading was as follows, giving total of 35 points.
Task 0 (pass/fail) Learning log, survey + video podcast 6 p (compulsory task)
Task 1 (pass/fail) I as a consumer poll & mind map 3 p
Task 2 (pass/fail) Getting to know future consumers 3 p
Task 3 (grade) How does plastic packaging engage you to circularity 0-5 p (compulsory task)
Task 4 (pass/fail) Group discussion: Engagement to circularity 3 p
Task 5 (grade) Circularity at different steps of value chain 0-5 p (compulsory task)
Task 6 (pass/fail) Bonus task 3 p
Task 7 (grade) Consumer engagement innovation project 0-10 p (compulsory task)

The overall grade distribution of the module Citizen and Consumer Engagement is seen in the following histogram.



In both courses the grades seemed to correlate on the activity of the course. Students not passing the course by the due date were given extra time to finish the activities.

- **Strengths, contingencies and barriers encountered**

Strengths

- The training contents were relevant to the learning outcomes and upgrading students' skills. The facilitation, supervision, and consideration of the needs of the students were strongly addressed by the teachers.
- The learning methodology adopted in the module suited well with the activities and gave the students opportunities to participative learning.

Contingencies

- Lack of participation of the students in the contact lessons was partly resolved by changing the times of the lectures later.
- The pre-set working groups for the module 4 courses was hampered by the non-attendance for the course (e.g., drop-offs from the previous module). The groups were re-organised during the first days of the course, but it still raised confusion and lost resources.
- Practicalities related to acceptance of tasks returned late from the given deadline were not aligned between countries (/different modules). Students assumed that if one country accepts late returns, this is possible in all countries, which posed resource challenges and confusion. In the Module 4, the students with missing assignments were given extra time for the late returns but for the sake of equity, by the cost of lower grades.

Barriers

- Some students, who were more used to working mostly with individual tasks and assignments, were reluctant for group assignment during the module 4. This may have reduced their motivation for studying and taking part in activities in time.

- **General assessment of the impact on students' competences and recommendations for future editions.**

The general assessment of the impact on students' competences and recommendations for future editions was mainly based on the feedback to the role play activity, documented in the discussion forum "Feedback discussion of the role play" as it showed the students' reflection of their learning. In this feedback discussion, students emphasized that this pedagogical model helped them learn about different stakeholders, "*see other viewpoints and the complexity of law making*" and to "*understand more realistically the topic of the debate.*" and "*Playing a role that you might not support is a hard, but at the same time very useful, experience*." Students also commented that the activity developed understanding on the need of compromises and multiple solutions. These are very valuable notions on the relationship of circular economy of plastics and the society. Also, there was learning on understanding scales "*It is easy to get lost in the details…and lose sight of the bigger issues*."

The campaigning part of role play also helped the students understand the importance of communicating one's message both to the decision makers and to the consumers. One student group wrote: "*We have also understood… that there is the need for public discussions and public events in general to share information about a lot of aspects concerning sustainability, reusing, recycling and so on.*"

Many students referred that they could see in the final discussion, that the others had acquired knowledge on the subject matter during the course. Students also referred to the knowledge construction process and mentioned that during the role play process they exchanged and shared information and cooperated within the group to achieve a common goal. Therefore, this course contributed also to cooperation, problem solving and communication competences of the students.

2.4. Module 5: CHAINs.

- **Brief introduction to the module.**

Finland

The Finnish CHAINs challenges and the weekly agenda was planned in close collaboration of TAMK and Pyroll. The four alternative challenges provided the students the starting point for the CHAINs addressed current relevant industrial challenges brought up by Pyroll. The broad objective of the CHAINs was to familiarise the students with the steps of the design innovation project according to the jointly coordinated CHAINs protocol and strengthen their (remote) group working skills and self-leadership in carrying out a challenging project. The topic-specific objectives were defined together with the students after they selected the specific topic. Although the CHAINs in Finland was mainly organised remotely; some face-to-face events were provided to support the learning as majority of the group was based in Finland.

Italy

During the CHAINs the Italian students were divided into two groups and each of them was assigned a challenge to solve. All the activities were planned in a very close manner with Proplast. In particular, two tutors were assigned according to the program. One from Proplast and one from UNISA. Both tutors have taken part in the working activities of the two students' groups. Although challenges have had very interesting results, the main scope of the CHAINs was to achieve the formation of a real team thinking for the participating students and to allow them to take the opportunity to apply in a practical way almost all the competences and information which were acquired during the previous training period. Unfortunately, all the activities were performed in remote mode.

Spain

Prior to the start of the Campus Iberus and Ecoembes module, a meeting was held to define and evaluate the challenges that would be proposed to the students. The company experts who would give a presentation on specific topics to help students understand the challenge were defined.
The module lasted 8 weeks:

- Definition phase, duration of 1 week. The objective of this phase is to understand the challenge
- Ideation phase, duration 3 weeks. The objective is to generate ideas, select those with the greatest potential and present them to a panel of experts.
- Prototyping phase, duration 4 weeks. The objective is to create a minimum viable product from the idea selected as a solution.

During these weeks the students collaboratively wrote a report, in which they placed the activities they were carrying out and their reflections on them.

Poland

During the CHAINs, the students were divided into two teams and worked for nine weeks within three phases.

The first phase consisted of the presentation of the Synthos company and AGH University, the introduction of teams and mentors, and discussion on organizational matters. Moreover, during the Definition phase, the challenge and involved actions for each team were presented and discussed briefly. Within both challenges, the challenge motivation, tasks, and expected outcomes have been established. The teams' challenges were as following:

Team 1 – Challenge 4	How we might effect on an improvement of the marketplace of biodegradable packaging in connection with green transformation of enterprises?
Team 2 – Challenge 1	How might we increase the share of bio-based polymers as alternatives of synthetic plastics in production of eco-packaging materials?

The second phase lasted four weeks and focused on the ideation, namely during this process, the students along with the mentors were creating and developing new ideas.
Subsequently, during the third phase the ideas, collected data and information, all the work that has been done during the previous phases were developed and implemented in order to achieve the final outcomes.

- T**raining techniques**

Finland

The training technique utilised in Finnish remote CHAINs emphasized the students' own activity in the learning process and empowering the students to take the lead in coordinating their own project to reach the goal in the given timeframe. The agenda was planned so that there was at least one topical lecture, expert visitor or study visit each week as well as a scheduled sparring sessions for any questions or support requests. The first week was focused on more informal team build-up activities and identifications of the team members' roles. Throughout the CHAINs, the students were advised to utilise Jamboard as a shared working platform so that each step remained documented, and the mentors could easily follow up progress. The mentors added supporting exercises to the Jamboard on demand bases to best support the project progress and worked them through with the students in joint meetings. These exercises included, for example, identifying the data needs, brainstorming, stakeholder mapping, needs' identification, customer value canvases, and a speedboat exercise. Further, the mentors gave topics for the students to work on for the next sparring session as homework. These activities were planned weekly based on the CHAINs project progress. It is worth mentioning that the students decided to establish a Teams chat group for the CHAINs project working and they invited the mentors to join this discussion group. This Teams group was effectively utilised as the information channel throughout the project, and it worked well in the informal communication.

Italy

The CHAINs activities were carried out through the different phases. The main aim of the CHAINs was to gather the skills acquired during the previous training modules. Thus, the first step consisted in some

synchronous activities with the mentors (both the industrial and academic) which were aimed to explain which were the expectations. Moreover, in order to allow groups to better work as a team, some games were performed according to the “design thinking” methodology. In particular, various Brainstorming activities were used to generate new ideas and solutions. The Challenges were explained after the first phase. Italian challenges were the following:

1) How a proper eco design strategy could induce consumers to be actively part of the packaging waste management?
2) What is the best strategy to increase the amount of plastic collection and recyclability?

During all the time of the CHAINs module, the groups were mentored by the two tutors at least twice a week for at least one hour. During these meetings, students were invited to explain the progress of their project; discussions about the problems and the solutions were really constructive.
All the synchronous activities and meetings were done by means of MS TEAMS. Moreover, the MIRò board was arranged for each group. By means of MIRò boards was made possible to perform the group works and activities related to the design thinking (e.g. the “start at the end”, the “swot analysis”, “pick a target” etc.). These activities had a very good response by students as also demonstrated by the challenges results.

Spain

The realization was remote with collaborative work, this was achieved through tutoring sessions with the academic and company mentor, the use of the course platform, zoom, editing and storage in the cloud (Google drive) and Miro (collaborative whiteboard).
Team building sessions and fostering communication, using reflection with the dynamic blind drawing. An additional communication channel was enabled using Telegram to shorten the response time between mentors and students.
Definition phase, a session with 2 experts from Ecoembes, one in ecodesign and the other in citizen science to help understanding. There were also dynamics to create mind maps, videos and readings in design thinking and integration dynamics.
Ideation phase, generation of design thinking technical ideas like crazy 8 guided by mentors, selection of ideas with the greatest potential, presentation to panel of experts, development of the idea with SWOT.
Prototype phase, mentoring sessions and development of business canvas and user map journal. Development of Marvel application.

Poland

In the implementation of the module as a training technique, firstly, individual lessons, exercises, and group discussions were used. Brainstorming, which is a creative group working technique, was used to generate new ideas and solutions. Short, medium and long-term business plans were discussed via SWOT analysis. Finally, in order to increase the effectiveness of group work, “thinking outside the box” was carried out. The main techniques that have been used during the CHAINs were lecture discussions and group work. Nevertheless, many other highly efficient methods have been used in order to help the participants to achieve the most satisfactory results. The discussions were held online via Microsoft Teams communication platform. The students did both the individual exercises and the group exercises. Moreover, besides the lectures and discussions with teammates and the mentors, the discussion with the company’s representatives was organized and conducted for both teams. It helped students to get

to know the company and its performance better within the researched area. It resulted in better understanding of the challenge, and thus had a beneficial impact on the work processes. In addition, debriefing and project review have been implemented during the CHAINs as the training techniques.

- **Summary of distributed materials**

Finland

Topical lectures on the innovation project were carried out according to the CHAINs methodology. The Jamboard document was jointly compiled during the exercise, and it contained several exercises brought by the mentors as well as content produced by the students. Face-to-face events were provided to support the learning of the Finnish CHAINs team:

- The visit to Pyroll Pakkaukset Oy Tampere site
- The lecture on Pyroll Packaging Media, organised by Pyroll Packaging
- The visit to PacTec-fair and following the PackAlliance panel discussion/workshop

Italy

The students were allowed to access various materials aimed to help them to solve the assigned challenges. In particular, by means of the Moodle platform, was possible to distribute all the necessary material for the understanding and performing the design thinking approach. These materials consisted in videos and presentations on the design thinking instruments.

Spain

The module material consisted of readings, videos, forums and presentations. Use of collaborative tools with training videos on the use of Miro
Training in innovation:

- Video explanation: what is design thinking?
- Innovation reading
- Video lesson with innovation forum

Team building

- Forum HBDI test

Definition phase

- Recording ecodesign expert
- Recording citizen science expert
- Labels and eco-design presentation
- Citizen science presentation

Ideation

- 2 videos on creativity

Poland

The materials that have been made available to students:

- Presentations of Challenge 1 and 4
- Brainstorming and SWOT analysis
- Exercises for creating a business model
- Selected reports from leading business magazines (McKinsey Quarterly)
- HBDI test
- Teamwork exercises
- Analysis of the different resources and consultations with Tutors:
  - scientific literature
  - official documents of the EU administration
  - market data from various sources
  - opinions and positions of various stakeholders of the packaging value chain
  - sustainability reports (including Synthos strategy EVERGREEN 2030)
- Own knowledge of students and information from organisations they are working for
- Consultation with Synthos Company's specialists of innovation and market

- **Participants evaluation and feedback**

Finland

The student feedback of the CHAINs was not collected by a general questionnaire, oral feedback obtained is presented in the next chapter.

Italy

Also, for Italian students, a feedback of the CHAINs was not collected by a general questionnaire. A personal feedback was reported by the participant in the final report of the Challenges.

Spain

In the last session of the module, students were verbally asked for their feedback, and they were also asked to briefly recount their experience in the report
Based on their feedback, what they value most was the multidisciplinary work, the tools they applied with Design thinking and the fact that they provided a solution to a real company challenge.

Poland

The participants of both teams, except of two students of Team 2, worked with great commitment and dedication. They were highly involved in the conceptual work as well as in the preparation of the final deliverables.
At the beginning of CHAINs, the guidelines for individual assessment for both teams have been created. The evaluation was conducted by the mentors according to the following criteria:

1. Active participation during the group work (40%):	Moodle activities (10 points);
	Report based on the group activities (30 points: 10 points structure, 20 points content).
2. Final presentation of the solution elaborated by the team (60%):	Construction of the presentation - 10 points
	Clarity of the presentation – 10 points
	Content of the presentation – 30 points
	Manner of presentation – 10 points

Regarding Team 1, the students provided full participation in all of the practices and exercises. They also successfully completed the tasks that they had to complete individually and as a team. Finally, they produced a very clear structured and well-written report. All students of Team 1 finished Module with score of 100%.
Regarding Team 2, two participants did not attend all meetings, as it was in the case of the rest of the team. However, they also contributed to the work progress. As it comes to the students who provided full participation, they effectively and successfully accomplish all the tasks both individually and as a group. The three persons of Team 2 fully involved in Challenge work were scored of 100%.

- **Strengths, contingencies and barriers encountered**.

Finland

Strengths
- Team build-up in the beginning was successful despite the challenge of remote working. All participants in the Finnish CHAINs team were active and motivated.

Contingencies
- Data and practices sharing between the project partner countries was not effective in the beginning of CHAINs. Instead, each country needed to do similar parallel activities. There is a clear possibility to streamline the activities between countries.
- Practicalities related to acceptance of tasks returned late from the given deadline were not aligned between countries. Students assumed that if one country accepts late returns, this is possible in all countries, which posed resource challenges and confusion.

Barriers

- Travelling hindrances due to geopolitical risk assessments in the participating countries. Instead of receiving international students, it was only possible to realise one remote CHAINs at the end which narrowed down the possible activities, collaboration, and international activities.

Italy

The main strength of the CHAINs module is represented by its results in terms of the experience, skills and confidence reached by the students in the field of food packaging and all the problems related to the circular economy. The approach and the methods which were used for the first time during this module was really appreciated by the students as they were able to achieve the solutions to the challenges in a strongly cooperative environment. The CHAINs module was also very important to finalize all the learning outcomes from the previous modules. Due to the lack of mobility due to the pandemy, it was necessary to perform all the activities online. From this point of view, the Moodle platform was really effective. Some problems were encountered with the synchronous activities due to the difficulties for the students to attend. These problems were faced by simply organizing the groups with time turnations according to the needs.

Spain

Strengths

- The team integrated and adopted remote collaborative work, the use of Drive to store and edit documents in real time was fundamental.
- The remote work among the team was flexible and adapted to the students' schedules; communication was good using WhatsApp.
- An activity board was created in Miro, which helped to coordinate the team's tasks, know the progress of these and the contribution of each student.
- Another team activity that helped both reflection and communication was to keep a logbook, where the activities performed and a reflection on them (which contributed to the team/challenge) were written down. In this way the students were also responsible for their own learning and application of skills and knowledge.

Contingencies

- The CHAINs competition was developed in parallel, generating stress in the students in the face of what they had to present in the module and in the competition.

Obstacles

- The module had a face-to-face and mobility approach, which could not be carried out due to political risks in the destination countries, so it had to be rethought in a virtual way. The adjustment to the online modality of the CHAINs forced each country to develop and apply the methods and tools they believed most convenient from the experience of the mentors.

Poland

Firstly, all of the remote meetings were really dynamic. Working with a small group was both very effective and productive. The participants actively joined to individual and group exercises but the number of participants for each group was only 3 (from the beginning for Team 1 and after some time, also for Team 2) and they had a pressure of time to complete their works. Very good contact and cooperation between students and tutors resulted in good results, even though the teams were smaller than assumed in the project. The willingness to complete the tasks and high motivation of participants helped them to solve the problems. Nevertheless, the resignation of some participants from the participation might have a negative impact on the rest of the team because the amount of the work was the same but the number of participants was smaller. Another aspect was the lack of opportunity for face-to-face meeting. The participants might not fully experience the project. Moreover, the fact that they did not know and see each other in person might at first decrease the effectiveness of the group work. Another obstacle was extremely limited time, giving a broad scope of assignment. Although both teams have managed very well, the limited time and the workload might have demotivated and stressed them. The lack of specific competition rules before the beginning of the Module 5 was not positively affected on work on design and preparation of the final products, in consequence could also have a demotivating effect on work.

- **General assessment of the impact on students' competences and recommendations for future editions.**

Finland

The impacts on the students' competences were assessed in Finland through requesting student feedback directly after completing the CHAINS. The students recognized the following impacts on their competences after the CHAINs:

- Distant team working competences were improved
- Project like working became familiar
- Tools to tackle a complex challenge and broaden own perspective towards the challenge were obtained
- Design thinking tools became familiar, and their impact became visible through the CHAINs
- Decision making capabilities were improved

Italy

The main positive aspects to be considered are represented by the concrete impact that CHAINs have had on the skills of the participant. Indeed, the use of the design thinking tools and the performing of group activities was really a crucial point that allowed students to improve their skills in all the fields involved in the training course.

Spain

The competencies that students developed and improved during the module are:

- Teamwork, including time management.
- Individually they applied responsibility and autonomy, they were able to collect, interpret and analyze information for the fulfillment of the challenge. Communication skills, both verbal and written.
- Creativity and innovation in the development of ideas and prototypes.

- Knowledge of design thinking tools.
- Knowledge of labeling legislation.
- Ability to calculate the packaging life cycle.
- User-focused product design through the creation of the application that provided a solution to the challenge.

Poland

One of the recommendations for future editions is increasing the number of participants, especially in the team. Moreover, it is suggested to give the participants additional time for the project and more limited scope. Better focus, less superficial tools, and more content are also recommended. The rules for evaluating the final products of the module Chains should be available to students before the course starts.

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