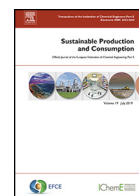




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Promoting sustainable consumption in Higher Education Institutions through integrative co-creative processes involving relevant stakeholders

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ABSTRACT

The United Nations proposes to ensure a sustainable future for all through the Sustainable Development Goals, assigning a new role to each individual in all sectors of society. Higher Education Institutions are outstanding agents of change, introducing and implementing sustainability in a holistic way, connecting people, and including social and institutional considerations, with students being a key component of change. This study presents a co-creation model to incorporate sustainability in Higher Education Institutions, integrating all members of the university community with a multidisciplinary approach, seeking to address global needs with development tools for new products and services to facilitate the transition of consumers towards responsible consumption. The model aims to analyze the daily consumption pattern of the community at the university, to identify the degree of commitment to sustainability of its members, and to co-create in search of solutions related to responsible consumption and production. This is achieved through five phases of a model, each with specific tasks and objectives based on co-creation processes and tools. As a result, the model enables stakeholders to understand the needs of their community by actively participating within the five phases for developing more democratic solutions and social involvement regarding sustainability issues that can be solved through a co-creative process. The model combines the benefits through ethnographic techniques to discover habits, tools to involve participation, and co-creation to manage complex problems. Future research will focus on the application of the proposed model to more generalist contexts of society, addressing potential challenges due to vertical collaboration and barriers pre-established by society for the adoption of a sustainable lifestyle.

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1. Introduction

The 2030 Agenda was established by the United Nations (UN), an international organization with a mission to solve problems facing humanity. The aim of this agenda is specified in 17 Sustainable Development Goals (SDG), which represent a considerable challenge. Nevertheless, achieving them will set the tone for leading the world towards economic, societal and environmental improvements (UN, 2015).

The problems identified through the UN SDG are interrelated. It is not enough to come up with solutions within one discipline. An

interrelation of specialized knowledge is required (Willamo et al., 2018). There is in fact a task for everyone in society, and it is essential to direct all activities towards innovation and sustainability through collaboration, seeking an alignment of global needs with new proposals. Given this situation, there is a need for focusing on the integration of sustainable learning, relationship management and support for more sustainable tools (Kruger et al., 2018). During several years, several methodologies and models from the design field have tried to introduce sustainability through collaborative processes between companies and designers to promote sustainable development by the improvement of products, services and the supply chain (Arnold, 2017).

A greater collaborative and interdisciplinary approach between all agents of change is required to achieve responsible consumption

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and production, as specified by SDG12. The aim of SDG12 supposes a challenging change of daily habits, including significant giving up of amenities we enjoy today. Even so, an interaction of all SDGs should be attempted, acting synergistically together, in order to guide the global system towards desirable outcomes and reduce the currently increasing levels of risk we face as a society (Cernev & Fenner, 2020).

Nowadays, Higher Education Institutions (HEIs) have been highlighted as outstanding agents of change, responsible for introducing and implementing sustainability in a more holistic way, connecting people, and including social and institutional considerations (Maher et al., 2018). Strategies and tools have also been incorporated in HEIs to promote sustainability among all members of the community, since their participation will help to delimit the full process of research or project development by targeting, facilitating and supervising sustainable transformations (Beringer & Adomšent, 2008; Keeyes & Huemann, 2017).

Working with students is a key factor as acquired knowledge tends to stay with young people, they are more open to accepting new ideas and later they will pass them on to the next generation (Joshi & Rahman, 2017). Addressing sustainability issues through universities is important in terms of education, research and community involvement since the application of solutions through higher education systems will be able to provide an enduring effect on the environment and society (Ralph & Stubbs, 2014).

By considering not only the internal community but also external communities, it is possible to promote transdisciplinary partnerships that will produce mostly positive changes for everyone involved (Beringer & Adomšent, 2008). It has been found that the involvement of all stakeholders is highly relevant to obtain valuable firsthand knowledge, to meet challenges, and to produce important findings to make easier transitions to a more sustainable future in HEIs, as reported in the studies by (Fissi et al., 2021), (Bien & Sassen, 2020) and (Perello-Marín et al., 2018). Most research lacks this involvement which should be arranged from the beginning to allow effective engagement for universities and their stakeholders (Gori et al., 2020). In many cases the lack of communication strategies more than anything leads to low responses from stakeholders when initiating research or implementing a new model or process. A more open and free dialogue is essential in order to include all interested parties (Kruger et al., 2018). In this context, introducing co-creation can help to achieve inclusive and more democratic solutions.

Co-creation refers to any act of creativity that is shared simultaneously by two or more people (Sanders & Stappers, 2019) and represents a powerful tool for achieving sustainable solutions in higher education. Focusing on the consumption demand, it applies equally in HEIs than in general society, so there can be a transition to sustainable lifestyles that later will impact in future workforce (Velazquez et al., 2006). considering external communities to promote transdisciplinary partnerships (Beringer & Adomšent, 2008).

The aim of this study is to propose a co-creation model to enable higher education communities to ideate new strategies to be applied in a responsible consumption context and to continue developing and applying them elsewhere. The model seeks to serve as a bridge between the different thinking profiles of the existing collectives in higher education institutions and their concerns and knowledge.

2. Literature review

To assure the quality of this research, a literature review has been carried out relating to experiences for the promotion of responsible consumption in HEIs and related fields. Published articles were taken into consideration mainly using the ScienceDirect and Web of Science search engines, while Google Scholar was used

as a support by using combinations of the following keywords: co-creation, sustainability, Higher Education Institutions, responsible consumption, etc. Models, strategies, and initiatives developed have been identified for sustainability and responsible consumption that possibly incorporated one type of co-creation and a community or a part of it. Table 1 presents the results of this literature research.

The literature review shows clearly that it is not only through HEIs that efforts have been made on developing initiatives. These have an impact on improving the behavior and consciousness of members of a community regarding responsible consumption, but there are also still limitations that can be addressed. What is evident through the literature review is the usage of co-creation processes for the development of solutions regarding sustainable issues, including also the importance of involving stakeholders from the beginning.

Most of the research studies analyzed only involved experts initially, and related results show that all community members should be taken into consideration with the purpose of developing true communication and effective engagement (Gori et al., 2020). Moreover, this analysis shows no evidence of a proposal involving two or more types of co-creation, much less the incorporation of creative processes or techniques which are “found to yield better and more meaningful solutions if established upon holistic framing and creative insight” (Tasdemir & Gazo, 2020). To increase awareness about responsible consumption through co-creation models, especially in an HEI context, it would be necessary to incorporate social media platforms due to their ability to reach the most numerous members of the community: students. These platforms, originally used exclusively for socializing, have been transformed into tools used by private and public institutions for creating engagement and awareness (Figueira, 2018) in a more extensive and rapid manner, also incorporating applications allowing faster analysis of information.

This research attempts to fill in the gaps found in the literature by means of developing a model for which a co-creation approach has been followed. The word co-creation was developed by academics and in industry, where an innovative change in the distribution of an organization was the target, in order to be able to work simultaneously and collaboratively with teams (Durugbo & Pawar, 2014). It can be defined as a creative process that is able to be carried out simultaneously by two or more persons, providing a collective dimension that encourages transformations in groups (Débora, 2015) and obtaining a mutually valued result in order to assure continuity (Pralhad & Ramaswamy, 2004). The co-creation methods considered in this study are the following:

Citizen Science (CS), for collecting information with the help of volunteers to complete and process information that is later helpful for showing data on a large scale (Rambonnet et al., 2019). In this case, the volunteers are specifically members of the university community. CS helps towards identifying and structuring problems based on community needs (Sauermann et al., 2020) and their own interpretation of the challenges that require more work. An example is the research study of Manolis & Manoli (2021) in which through an innovative and effective approach, awareness of the SDGs was raised through creative projects while providing and using a reliable questionnaire which investigated their impacts on participating students.

Collective Intelligence (CI), which arises from the collaboration and competition among several persons, where there is a focus on gathering insights from the community that will stimulate designers' creativity (Lee & Chang, 2010). The combination of collective human brain power and modern information technology represents a useful tool for the development of projects for sustainability (Sierra-Pérez & López Forniés, 2020a). An example is given in (G. Trencher et al., 2017) which examined the historical

Table 1
Results for the literature research related to the proposed model.

Author/Year	Paper	Publication	Applicability	Level	Co-creation	Participants
(Fissi et al., 2021)	The path toward a sustainable green university: The case of the University of Florence	Journal of Cleaner Production	HEI	University	Living Lab	Not specified
(Manolis & Manoli, 2021)	Raising awareness of the Sustainable Development Goals through Ecological Projects in Higher Education	Journal of Cleaner Production	HEI	Faculty	-	44 students
(Font et al., 2021)	Value co-creation in sustainable tourism: A service-dominant logic approach	Tourism Management	Tourism	-	-	Not specified
(Tasdemir & Gazo, 2020)	Integrating sustainability into higher education curriculum through a transdisciplinary perspective	Journal of Cleaner Production	HEI	Degree	-	Eight students
(Laurenti & Acuña, 2020)	Exploring antecedents of behavioural intention and preferences in online peer-to-peer resource sharing: A Swedish university setting	Sustainable Production and Consumption	HEI	University	-	325 community members
(Bien & Sassen, 2020)	Sensemaking of a sustainability transition by higher education institution leaders	Journal of Cleaner Production	HEI	University	Co-creation towards sustainability	Eight deans, vice-deans and vice-residents
(Gori et al., 2020)	Toward the Dissemination of Sustainability Issues through Social Media in the Higher Education Sector: Evidence from an Italian Case	Sustainability	HEI	University	Co-creation towards sustainability	Based on social media followers: 54,225
(Kumari et al., 2020)	Co-Creation for Social Innovation in the Ecosystem Context: The Role of Higher Educational Institutions	Sustainability	HEI	HEI's in general	Co-creation for social innovation	Not specified
(Caeiro et al., 2020)	Sustainability and Benchmarking in Higher Education Institutions—A Critical Reflection	Sustainability	HEI	University	-	Not specified
(Bolmsten & Kitada, 2020)	Agile social learning – capacity-building for sustainable development in higher education	International Journal of Sustainability in Higher Education	HEI	Degree	-	Not specified
(Clark et al., 2020)	Sustainability coursework: student perspectives and reflections on design thinking	International Journal of Sustainability in Higher Education	HEI	Course	Design Thinking	30 students
(Palakshappa & Dodds, 2020)	Mobilising SDG 12: co-creating sustainability through brands	Marketing Intelligence and Planning	Fashion Industry	Lululemon and Kowtow	Brand co-creation	Not specified
(Tajvidi et al., 2020)	Brand co-creation through social commerce information sharing: The role of social media	Journal of Business Research	Branding/Marketing	Not specified	Brand co-creation	Not specified
(Kumar & Dholakia, 2020)	Firms enabling responsible consumption: an ethnographic approach	Marketing Intelligence and Planning	Branding/Marketing	Social Media	Collective Intelligence	38 online platform sources
(Leal Filho et al., 2019)	Sustainable Development Goals and sustainability teaching at universities: Falling behind or getting ahead of the pack?	Journal of Cleaner Production	HEI	University	-	167 community members
(Mendoza et al., 2019)	A methodological framework for the implementation of circular economy thinking in higher education institutions: Towards sustainable campus management	Journal of Cleaner Production	HEI	University	-	Not specified
(Chin et al., 2019)	Co-creation of Social Innovation: Corporate Universities as Innovative Strategies for Chinese Firms to Engage with Society	Sustainability	HEI	Corporate University	Co-creation for social innovation	600 employees

(continued on next page)

Table 1 (continued)

Author/Year	Paper	Publication	Applicability	Level	Co-creation	Participants
(Soini et al., 2019)	Transactional learning and sustainability co-creation in a university – business collaboration	International Journal of Sustainability in Higher Education	HEI	Course	Collective co-creation	39 students
(Mackenzie & Davies, 2019)	SHARE IT: Co-designing a sustainability impact assessment framework for urban food sharing initiatives	Environmental Impact assessment Review	Food sharing	Food consumption	Co-Design	38 urban food sharing initiatives
(Tunn et al., 2019)	Business Models For Sustainable Consumption In The Circular Economy: An Expert Study	Journal of Cleaner Production	Business models/Fashion Industry	-	-	22 Circular Economy and Sustainable consumption experts
(Schröder et al., 2019)	Advancing sustainable consumption and production in cities - A transdisciplinary research and stakeholder engagement framework to address consumption-based emissions and impacts	Journal of Cleaner Production	Sustainable cities	San Francisco (US), Kyoto (Japan), Pune (India)	-	3 case studies
(Perello-Marín et al., 2018)	Enhancing Education for Sustainable Development in Environmental University Programmes: A Co-Creation Approach	Sustainability	HEI	University	Value co-creation	12 universities (Ecuador)
(Merz et al., 2018)	How valuable are your customers in the brand value co-creation process?	Journal of Business Research	Marketing	Customer Co-creation Value	Value co-creation	Not specified
The development of a Customer Co-Creation Value (CCCV) scale (G. Trencher et al., 2017)	Implementing Sustainability Co-Creation between Universities and Society: A Typology-Based Understanding	Sustainability	HEI	Partner organizations for universities	-	Two researchers and one organizational representative
(Charli-Joseph et al., 2016)	Collaborative framework for designing a sustainability science programme	International Journal of Sustainability in Higher Education	HEI	Degree	-	50 faculty members
(Kaufmann et al., 2016)	Exploring behavioural branding, brand love and brand co-creation	Journal of Product and Brand Management	Branding/Marketing	Behavioural branding	Brand co-creation	Not specified
(G. Trencher et al., 2015)	Student participation in the co-creation of knowledge and social experiments for advancing sustainability: experiences from the University of Tokyo	Environmental Sustainability	HEI	University	Collective Intelligence	Not specified
(Barth et al., 2014)	Learning to change universities from within: a service-learning perspective on promoting sustainable consumption in higher education	Journal of Cleaner Production	HEI	University	-	Six educational organisations
(G. P. Trencher et al., 2013)	Co-creating sustainability: cross-sector university collaborations for driving sustainable urban transformations	Journal of Cleaner Production	HEI	University	Living Lab	27 partnerships in Europe, Middle East, Asia and North America
(Liedtke et al., 2012)	LIVING LAB: user-driven innovation for sustainability	International Journal of Sustainability in Higher Education	HEI	Market Innovation	Living Lab	Not specified
(Alshuwaikhat & Abubakar, 2008)	An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices	Journal of Cleaner Production	HEI	Campus	-	Not specified
(Velazquez et al., 2006)	Sustainable university: what can be the matter?	Journal of Cleaner Production	HEI	University	-	80 HEI

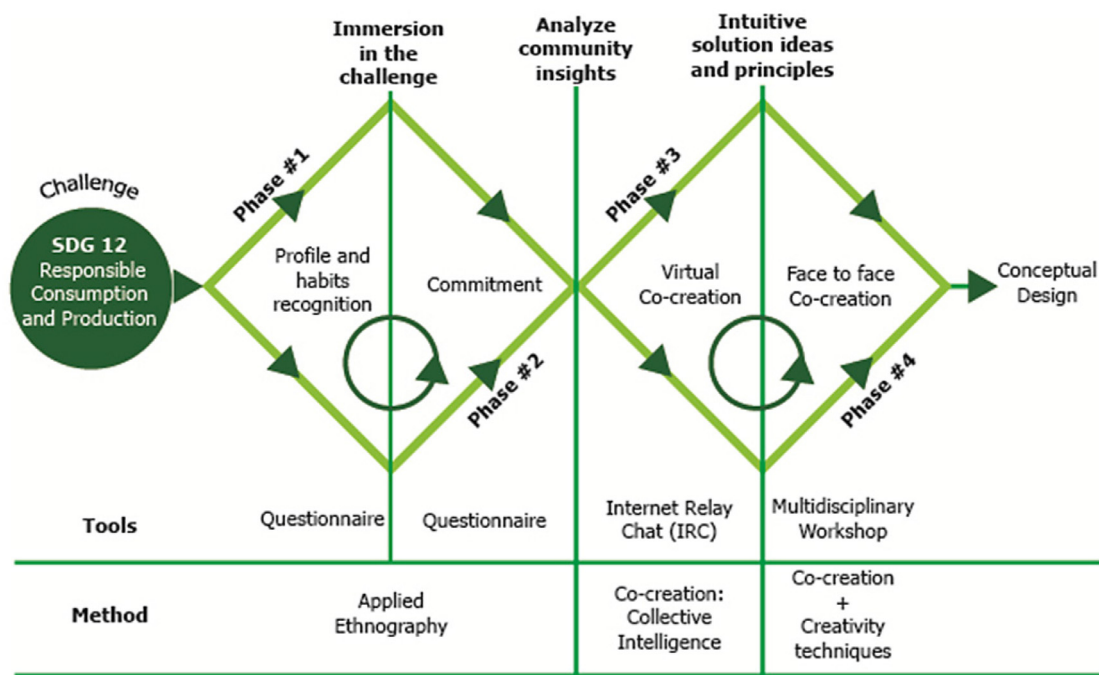


Fig. 1. Brief description of the design model showing its core elements.

and ongoing experiences of five organizations in Japan that actively seek partnerships with universities to enhance sustainability activities and strategies to transform society.

Design Thinking (DT) is a co-creative process that uses the sensitivity of the designer to balance the needs of the users with what is feasible and to achieve viability through strategies that can manage to turn those needs into value for the user and market opportunities (Brenner & Uebernickel, 2016). One of the values of DT is the ability to adapt to diverse scenarios, the educational one in this case. An example is the research study of Clark et al. (2020) reporting on the development of a pedagogical process that incorporated DT into a course of Design for the Environment, enhancing students' creativity and future sustainability practices.

With our model, we aim to provide divergent thinking, new strategies, challenges, ideas, opinions, and opportunities through the co-creation processes that have been incorporated and are being developed by the members of the university in response to their requirements. By being involved, community members will ideally develop the level of consciousness required to achieve a sustainable lifestyle (Szerényi et al., 2011). By changing the way people behave and by involving them in the process leading towards responsible sustainability, the results of applying the model are more likely to improve, thus raising awareness (Redante et al., 2019).

3. Methods

The model has the objective of developing awareness within the HEI by showing members of the institution that their involvement in such initiatives can enable them to reach a level of consciousness leading towards a sustainable lifestyle in and out of campus (Szerényi et al., 2011). The development of the design model was done by incorporating research, creative thinking tools and co-creation processes in five phases, each with specific objectives and tasks. Figure 1 provides a rapid visual description of the model. It can be seen that its structure is based on the Double Diamond Process (Design Council, 2019) which was created to permit designers to solve the most complex social, economic and environmental

problems. Each phase begins with an identified problem or need that has been selected from the previous phase, except for phase 1 which depends on the case study addressed and the identified needs and problems.

3.1. Phase #1: Profile and habits recognition

The objective of this phase is to research and discover the daily consumption habits of the participating community members by means of a face-to-face questionnaire, related to SDG 12. Understanding the perceptions and the reasons of the participating community for their consumption habits is important (Marchand & Walker, 2008). The responses can affect other SDGs, depending on the context of the project, and allow us to identify trends within consumption habits that can provide an opportunity to redesign, reorganize and rediscover the baseline situation.

The recognition of consumption habits is backed up by the fact that nowadays we are aware that more citizens have a good understanding of local conditions and that their motivation is to make contributions through their skills, observations and experiences, which helps projects to lower monetary incentives and this is facilitated by the principles of Citizen Science (Freihardt, 2020). For this reason, it is recommended to consider when designing the questionnaire which aspects in SDG 12 are related to the place where the model will be implemented. And which activities are notorious or repetitive for the user.

It is proposed that the questions should mostly be limited to multiple option answers (yes/no answers and Likert scale answers). In this way the information processing is faster and the measure of responses will be evaluated equally. One open question might be included to visualize other problems and detect more specific or personal aspects that may be of interest, which may not have been considered from the beginning.

3.2. Phase #2: Commitment

The objective of this phase is to determine the limitations of consumers when changing a daily habit, either for a different prod-

uct or service or for a change in attitude and behavior. It is important to consult users because the consumption process includes aspects such as decisions or routine activities that must be considered to make the act of consumption palatable and reliable, and users should not be forced into doing unwanted activities (Selvfors et al., 2019). Therefore, the quality of the data collected will influence the results of the subsequent co-creative process.

In this case, supported by co-creative processes such as citizen science (Bonney et al., 2014), we seek to carry out quick consultations with immediate responses through social networks. This consultation process intends that the user is situated in a future scenario where their consumption habits could be modified and expresses their acceptance or not. In this way, the most important limitations can be identified and the areas of the consumption process in which they occur.

Online surveys work by allowing respondents to participate more freely than being asked in person (Freihardt, 2020), favoring more faithful responses with their real commitment to the environment. The survey is composed of five questions based on the results of the questionnaires of Phase #1, requiring a YES / NO answer. Each question is released during different weekdays through the social network with greater access to the different agents of the community.

The analysis of the results of this phase can be described as simple, since online survey platforms are able to automatically provide the results which are shown by percentages.

3.3. Phase #3: Co-creation

Once the patterns of consumption and the limits of the community members have been identified, a process of co-creation between the different agents of change in the community is proposed. Co-creation can lead to a growth in knowledge and create new collaborations between users for the improvement of the community (Sanders & Stappers, 2008). Also, co-creative processes encourage the ability to adapt in diverse scenarios that allows the study of several educational intentions, motivation for participation and the generation of changes of the community members, enabling these members for being actors of change (Sanders & Stappers, 2019).

During this phase, the process of co-creation and creativity is divided into two sub-phases. The first initial activity of co-creation is carried out online where the work teams do not know each other and do not share a physical room. The second stage is face-to-face co-creation, based on the results of the first session, with several creative teams working in parallel and sharing information and experiences.

3.3.1. Virtual co-creation

The first session of co-creation was focused on design groups for a virtual co-creation session based on Computer Mediated Communication (CMC), using an Internet Relay Chat (IRC). It started from the inquiries made in Phase #2 focusing on the improvements in the field of study to achieve responsible consumption. A couple of challenges were proposed taking into account the questions with the most answers in Phase #2 and those that had a more positive result in terms of generating change. Another purpose of this session was to set a dynamic environment in which people can do a rapid brainstorming related to the given challenge and come up with as many ideas as possible. Also, this activity is developed through an IRC, which “by definition is a ‘public’ space and has been serving as a playground for group activities, providing many possibilities for self-expression and group interaction” (Fung & Carter, 2007). The usage of computational tools available for the generation of innovative ideas and problem solving by the

application of collective intelligence is a collective effort (CI) (Lopez Flores et al., 2015).

The model proposes that this session be divided into three parts. The first one is for the preparation of topics to discuss and is focused on the relevant conclusion of Phase #2. Then, the creative process is divided into two challenges where the participants need to give ideas on how to improve, how to work towards a better design and what to propose as an alternative for the problems related to responsible consumption presented to them. The first part is divergent, in which participants identify solutions for the challenge in general terms. During the second part, each creative group goes to a convergent phase to specify solutions focused on the reality of the context in which the challenge is framed.

For the case study, the selection of participants includes specialists in Eco-Design and Sustainability, students and teaching and administrative staff. The composition of the teams should be diverse, and all the experts or community agents in each group will be represented.

The analysis of the results for this session is made through a Creative Product (CP), which is the Potential (P) per Applicability (A): $CP = P \times A$. This metric for evaluating creativity allows the measurement of ideas with various parameters, two in our case. The first one is the potential of the idea, where the novelty and ability to function is measured. The second one is the applicability, measured by to what extent it can be completed, and its feasibility taking into consideration material, human, time and monetary resources that can be internal or external (López-Forniés et al., 2017). The internal resources will be those available within the community, and the external will be those available from outside the community, such as suppliers and companies. Tables 2 and 3 show the descriptions of each score for Potential and Applicability.

Ideas with a score of three or four in Table 3 which do not depend on external resources for their implementation should be considered as a challenge for the next co-creation session.

- 1 Ideas that show a (CP) equal to or higher than 6 should be considered for the next co-creation session.
- 2 Recurring ideas during the session, arising several times between IRC rooms, indicate a converging point of interest and can be included in the challenges for the next co-creation session even despite having a neutral CP.

3.3.2. Face to face co-creation session

The second part of the co-creation process is face-to-face sessions. The sessions were carried out through the use of different creativity techniques to work on the most valued ideas of the virtual co-creation phase by applying the proposed metric.

The session begins with a presentation where the participants get to know what the dynamic will be and who they will be working with. There is a minimum of two groups in the session, which should include students, teaching and administrative staff and specialists in Eco-Design. All the participants are considered part of the problem and part of the solution, which is why all interested parties need to be considered for participation. The design of these sessions, including time and material, is as shown in Figure 2 and is further explained below.

a) Face to face co-creation: First part

This part begins with an individual brainstorming session about seed ideas taken from the virtual co-creation session. This individual part fosters creativity for each participant and the ability spontaneously to find the solution of the presented problems (Al-Samarraie & Hurmuzan, 2018). During this part, it is recommended that the ideas be described in short sentences and each participant proposes a minimum of three to be shared with the group. These should be stuck on the wall for better viewing. Afterwards, a group

Table 2
Potential measurement for the ideas from virtual co-creation session.

Potential (differentiation factor)	Score	Means
Without potential	0	It already exists
Low potential	1	It already exists but not in this environment
Neutral potential	2	It already exists but it brings differentiation
Medium potential	3	It already exists but it brings more than one difference
High potential	4	There is nothing similar

Table 3
Applicability measurement for the ideas from virtual co-creation session.

Applicability (Resources and independence for development)	Score	Means
Without applicability	0	We are not able to do it (External resources needed)
Low applicability	1	We can do it with support (external and resources needed)
Neutral applicability	2	We can do it with support (external or resources needed)
Medium applicability	3	We can do it with support (HR and higher budget)
High applicability	4	We can do it (with low budget and less HR)

Scores can be arranged according to the objectives and necessities of each project during the application of the model. For our case study, the idea filtration follows three considerations:

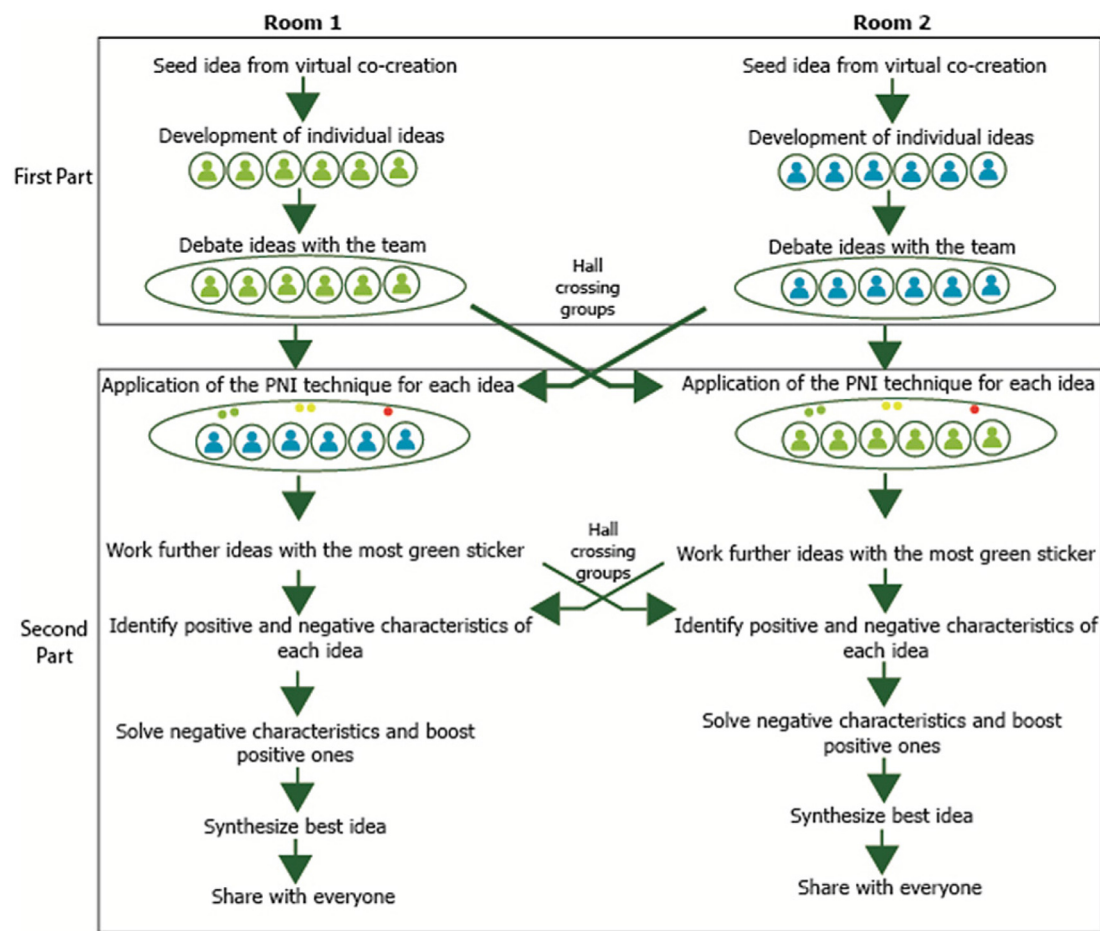


Fig. 2. Scheme of the face-to-face co-creation session of the design model.

work is carried out where the ideas raised individually are grouped together, a debate is generated, and new ideas are obtained. Finally, each group shares a synthesis of the ideas with the other group for about 7 minutes.

a) Face to face co-creation: Second part

For this part, a Positive–Negative–Interesting (PNI) technique (De Bono, 1994) is applied where every idea is evaluated in a very detailed manner by highlighting the positive and negative aspects of each one. This reveals their potential and also enables the classi-

fication of additional ideas that cannot be identified as positive or negative. This method helps to identify why an idea would be successful and to prevent weaknesses.

There is a hall crossing for the groups where an evaluation of the ideas is made for five minutes through a PNI technique. Every participant votes a Positive, Negative and Interesting option explaining the justification of their decision. The idea with the highest number of Positive votes is the one that needs to be worked further.

Individual work is then carried out for three minutes to identify positive and negative characteristics raised during the PNI that will be discussed later. A working group will then be formed to solve the negative characteristics and boost the positive ones. A final synthesis needs to be done to fully represent the idea. In this part, participants are invited to do rapid sketches if possible.

The final part gathers both groups together one last time in order to share the final ideas and, if possible, to have a debate about how the idea might go further, all of this for six minutes. At this point the session can be closed by the moderator.

3.4. Phase #4: Conceptual design

This phase checks that there has been a full understanding of the problem, identifying the user needs through creativity techniques and tools, which have been incorporated during all the previous phases. This leads to the development of a design brief that the designers should draft taking into account the data and final ideas expressed in Phase 4. At this stage, ideas are further evaluated and developed into a tangible project.

4. Results: application of the model to promote responsible consumption in a HEI

The model was applied at the School of Engineering and Architecture (EINA) of the University of Zaragoza (Spain) involving students from several academic programs, teaching staff and administrative staff. Thus, all parties of interest were involved in the data collection. The model was completed in four months and all the phases described above were successfully developed.

4.1. Case study: University of Zaragoza (Spain)

The proposed co-creation model has been applied in a case study within the Strategic Sustainability plan of the School of Engineering and Architecture (EINA) of the University of Zaragoza (Spain). This plan aims to incorporate sustainability in the different areas of its activity: academic, research, students, and daily management (installations, consumption, administrative operations, management procedures).

The case study is framed in the everyday management area, specifically in the consumption of resources by all members of the institution, and it is focused on the hospitality services, such as coffee shops, restaurants, and vending machines. The variety offered to consumers allows them to take into account three principal considerations: personal preferences, convenience and sense of responsibility (Gelinder et al., 2020).

EINA is composed of 4,617 people, including 3,907 students (85%), 550 teaching staff (12%) and 160 administrative staff (3%). They are distributed in three main buildings for academic, research and services purposes. All the buildings have a cafeteria service, canteens and several vending machines for hot and cold drinks and food.

The model was implemented as shown in Figure 3:

4.2. Results Phase #1: Profile and habits recognition

Using the questionnaire, 152 short face-to-face interviews were conducted in the EINA buildings with students, professors and administrative staff within a week. The results are indicators of their own knowledge about their daily life in the university and their degree of commitment to the adoption of sustainable improvements.

The questionnaire includes 10 questions on topics related to the activities that are part of the day-to-day life of most members of the university, their knowledge of the SDGs and their commitment to sustainability:

- Transportation
- Eating habits and purchasing food at faculty
- Level of water bottle consumption
- Waste separation
- Usage and care of electronic devices
- Paper use

These topics focus on the principal facilities at the university, services that are available for all faculty members. The main purpose of incorporating these into the questionnaire is to gather information in the most focused and summarized manner. A few specific questions in the questionnaire showed a better understanding of the problems at the EINA; these are shown in Figure 4. The rest of the results can be consulted in the Supplementary Material.

The results were analyzed and topics that showed a negative attitude towards sustainable responsibility were selected to be addressed in the next phase, since their implementation could lead to significant improvements.

4.3. Results Phase #2: Commitment

The responses on knowledge about sustainability and the willingness to participate in activities to improve and implement innovative initiatives were divided between respondents who showed interest and those who did not. That was an indicator of the opportunity to develop proposals and involve all stakeholders between respondents, who want to participate in the first place and trying to encourage those who said no.

The rest of the answers showed the daily uses of faculty facilities and their repeatability, which helped to make a better selection of situations that take place daily and on which to carry out an intervention within the resources of the university.

Once the potential situations for action had been identified, 5 questions were launched on the university's Instagram account (@einaunizar). With 285 followers, this is the most used platform and was selected to reach the largest number of students possible, as these are the most active group on the platform. In addition, students often obtain their information on sustainability from social networks, so incorporating relevant messages and queries through these types of media is effective (Ahamad & Ariffin, 2018). There is an automatic tool available for conducting polls and the results are easy to visualize. These can be seen in Table 4:

4.4. Results Phase #3: Contributions of co-creation

In this phase, ideas were identified to develop feasible solutions in terms of consumption habits, thanks to the active groups of participants made up from different EINA departments.

4.4.1. Virtual co-creation

The first of the co-creation sessions took place via IRC. In one of the rooms it was possible to prepare the material for the session, prior to the arrival of the participants: EINA's Deputy Director of Quality and Sustainability, a specialist professor in Eco-design, four students, a non-specialist professor and 2 members of the EINA management staff. The platform used was *Bloochat* (<https://bloochat.com/>), which allows the creation of chat rooms with passwords so it was possible to have control over who and how many participants were in a session.

In the session, three different topics were addressed simultaneously (table 5), considering the problems detected in the previous phase regarding waste and single-use containers. To begin there was a presentation to the participants, letting them know why they were invited to participate and the objective of the project. The instructions for their contributions were as follows:

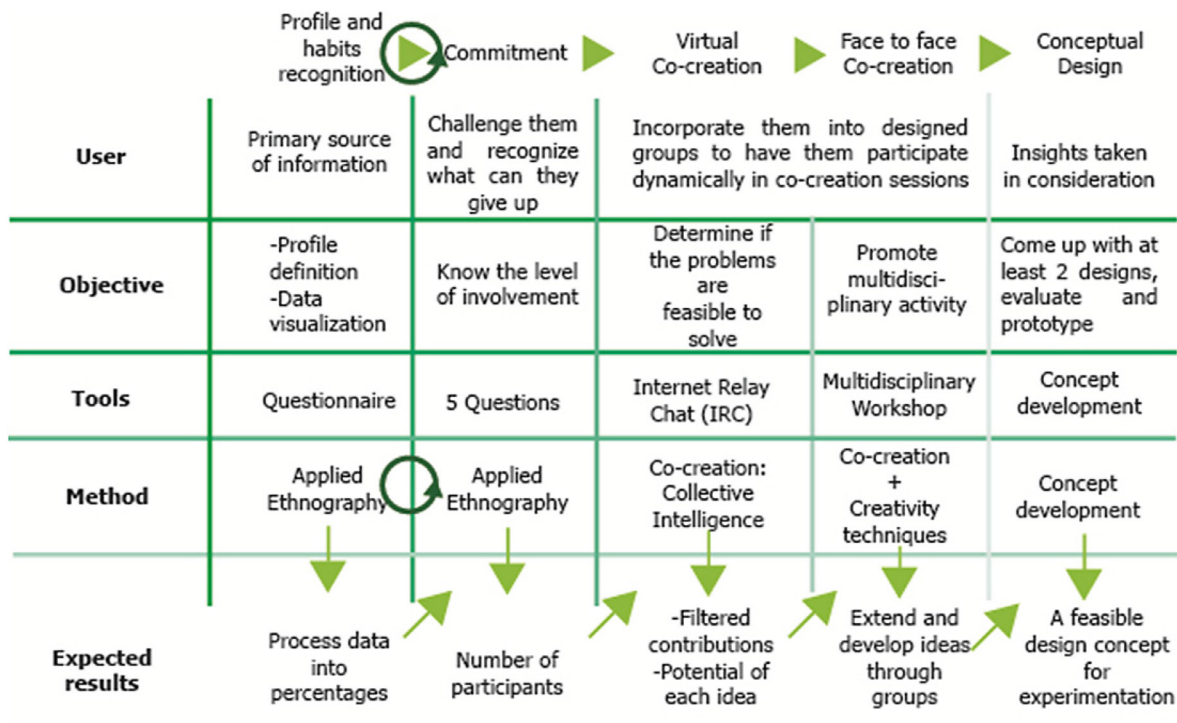


Fig. 3. Extended scheme version of the creative model

Table 4

Results of the rapid polls done through the Instagram account of the EINA.

Question	Question	Participants	Yes	No
1	Would you commit to separating all your waste?	47	91.48%	8.51%
2	Would you commit to zero residue during your time at school?	25	96%	4%
3	Would you commit to stop using single use containers?	35	82.85%	17.14%
4	Would you commit to not consuming processed products?	40	72.5%	27.5%
5	Would you commit to reducing paper consumption and using more digital media?	30	73.33%	26.66%

The results show that there is a positive response towards making a change in all the inquiries that were launched, so the tendency shown by this is that people may accept the change and eventually agree to be part of it.

Table 5

Challenges discussed during the virtual co-creation session.

Chat room Topic	1	2	3
	Waste separation	Single use containers	Zero residue target at EINA
First Part	Now, the waste separation at the university is not considered satisfactory. How would you improve the waste separation at school (cafeteria, classrooms, halls, offices...)? There is a great consumption of single use containers. What would you propose to reduce or eliminate single use containers for food and drinks (water bottles, plastic and paperboard coffee cups, plastic wraps...)?	There is a great consumption of single use containers. What would you propose to reduce or eliminate single use containers for food and drinks (water bottles, plastic and paperboard coffee cups, plastic wraps...)? In an ideal world the residue should be zero. How do you think we could make feasible that our footprint through school can be near zero?	In an ideal world the residue should be zero. How do you think we could make feasible that our footprint through school can be near zero?
Second Part	Containers seem not to be the ideal solution. What alternatives can you come up with for placement of containers for waste separation?	Second part – If we think of products without a container, what would you propose as alternatives and healthier food and drinks?	There are factors like education, family, regulations, business objectives, etc. that affect the generation of residues. How could we work with these factors to improve the current tendency?

After the session ended, data from the IRC chat rooms was collected for analysis. A total of 115 entries were made in the session and ordered through the (CP) displayed in Table 6, using the scores that have been previously presented. The ideas were then divided as follows:

Table 6
Creative Product applied for the analysis of the results in the IRC session.

Challenge	Participants	To be considered 4 Score	For consideration ≥ 6 Score	Evaluate high incidence on replica with a neutral or high CP index Interactions
1	3	2	7	2
2	3	6	3	10
3	3	2	3	3

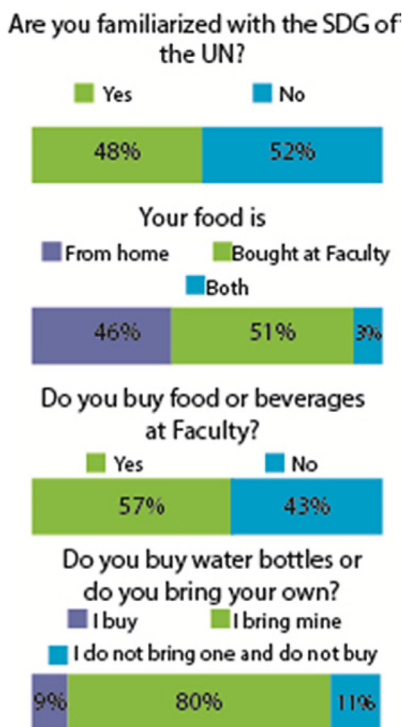


Fig. 4. Graphic showing general results.

- The session would be brief, each given a challenge (two per chat room) lasting 8 minutes each with a break of two minutes between them to allow the participants to prepare for the next one, as seen in Table 5.
- There were limitations on the proposals or ideas.

Ideas that scored ≥ 6 related to single-use containers and to raising awareness of campus staff to ensure that the proposals to be implemented were achieved. The results show that there is awareness about the development of actions that can help to achieve sustainable objectives, but that it is necessary for people to be more aware of the problems in which we live so that the designed products are used positively and voluntarily.

4.4.2. Face to face co-creation session

The face-to-face session of phase three was held simultaneously in two rooms at the EINA. As in the previous session, all staff were invited and there was a total of 16 participants divided equally in both rooms: 10 students, two teachers, 4 administrative staff.

There was a brief introduction giving an explanation of the purpose and how the session was to be developed, as follows:

- The two groups are active simultaneously. Each session will have two parts, the first deals with the generation of individual ideas that are shared within each group. Afterwards, both groups will share their ideas. And in the second part of the session the groups will work with the ideas of the other group.

The results of each stage of the session in both rooms totaled 33 contributions, of which some could be grouped as shown in Table 7:

The results of the PNI analysis show that there was a convergence in the evaluation. For the selection of negative ideas all the participants agreed with the same ones, so it can be assumed that it was clear that those ideas would not work or did not have enough potential to take them into account. The selected ideas as interesting or positive had a relevant difference with others. It could be seen that the ideas with the best acceptance had an advantage of at least two points. **4.5 Conceptual design**

The ideas selected with the NIP analysis were further developed with the intention of obtaining a more detailed concept. This was also achieved through individual contributions on sticky notes that expanded each idea.

The development of the first concept was provoked by the high consumption of single-use packaging. A design competition for a kit with airtight bottles and containers was proposed. The needs to be considered were:

- Modular design
- Customizable
- Material and process selection that does not represent damage to the environment
- Consideration of economic and time resources given by the EINA to produce the products

The second concept was related to educational, family and regulatory factors and commercial objectives that negatively affect the generation of waste. Through this proposal, the participants in the session sought to increase the commitment of the EINA members.

The proposal was to arrange a contest based on obtaining points as a reward for participation in various activities focused on generating positive habits and good practices for Responsible Production and Consumption (SDG 12) at EINA. The activities can be defined by the organizing committee, which can include a group of committed volunteers and the school management, and the scoring system would also be accounted for by them. This initiative should consider:

- Personalized marks on the containers considering technological devices such as RFID.
- Create a system to avoid fraud.
- Reach the highest possible levels of participation
- Define the rewards.

5. Discussion

The level of participation was not regular during the development of the proposed model, medium-high in the questionnaire and face-to-face co-creation sessions, and low in the online surveys and virtual co-creation. These results lead us to reflect on the convenience of transmitting the sustainability message through a coordinated group to achieve greater participation (Fissi et al., 2021; Liedtke et al., 2012) or, on the contrary, whether it is better to use online systems or social networks (Laurenti & Acuña, 2020; Gori et al., 2020) that have been shown to be effective. Analyzing the present results, it seems more appropriate to deal directly

Table 7
Grouping of the ideas from the contributions for the face-to-face session.

Contributions room A	Contributions room B
<p>1 Cool EINA bottles Bottle Design contest Encourage the usage of airtight food storage containers Formative solutions</p> <p>2 Rent of cutlery and airtight food storage container Usage of initial kit that can be returned</p> <p>3 Establish a collaboration with cafeteria for supplying recyclable cups Lockers in cafeteria to leave your cup Discounts in cafeteria when you carry your own food container</p> <p>4 Nothing to wash since it wastes much water Cleaning of reusable containers</p> <p>5 Bulk machines Paperboard containers Discounts when buying at cafeteria if you take your container Bulk machine for beverages</p> <p>6 Metallic or glass bottles with a removable base Penalize 10% in price to those who use a recyclable container Bottles vs Cans</p>	<p>1 Annual contest of sustainable design System of rewards Social media visualization Reward good actions</p> <p>2 Registration system that identify who did not clean cafeteria utensils</p> <p>3 Sustainable Design congress Environmental congress with presentations of companies, students and professors</p> <p>4 Complementary activities to classes</p> <p>5 Attach sustainability to companies</p> <p>6 Don't throw away food, but save it</p> <p>7 Not setting standards for usage of food containers New spaces for lunch Specifications for the cleaning company Give a second life to old products Café repair</p> <p>8 Energy efficiency at EINA</p>

Next, different ideas were worked on in each room in order to develop those that had the most potential. Afterwards, the application of the PNI analysis was carried out. These results can be viewed in [Table 8](#):

Table 8
PNI analysis made by the participants to develop ideas with more potential.

Contributions room A			Contributions room B		
Idea related to	Idea	PNI	Idea related to	Idea	PNI
1	Contest of design for bottles and containers	5 3	1	Thematic contest in cafeteria	1
2 and 3	Modular service in cafeteria	5 3	1	Contest that gives rewards and generates habits	1 5
N/A	Contest between universities to count consumption of plastic	8	6	Do not throw away food, share it campaign with posters, videos and audios to raise awareness	7
			7	Repair workshop	5 2

with people to achieve engagement, given that HEIs have the potential to become participatory spaces of open innovation and living labs for sustainability if sufficient and long-term participation is achieved.

Low results in the co-creation sessions indicate that either the ideas are not novel, which may be due to the time devoted to each session, or that their applicability is dependent on having external support from companies or sponsors, such as in the work oriented to social innovation establishing collaboration strategies between HEI, companies and society (Chin et al., 2019; Kumari et al., 2020; Trencher et al., 2013), or collective intelligence (Kumar & Dholakia, 2020; Trencher et al., 2015). However, the design and creative processes tools used gave some interesting proposals with the poten-

tial to carry them out with our own resources, showing that HEIs are able to achieve positive change (Beringer & Adom̂sent, 2008).

The inclusion of all members of HEIs is a key factor for meaningful and complete transitions towards initiatives for a sustainable lifestyle (Bien & Sassen, 2020). Nowadays HEIs should not have teaching and research as their only objectives (Gori et al., 2020), they should also encourage stakeholders to adopt more and better sustainable practices that will have an impact in the short, medium and long term for society. This is where co-creation comes in, by working on developing knowledge, competences and values for the design for sustainable practices, as established by Perello-Marín (2018). It also has a long-term benefit for the student population and society since knowing how to use these creativity tools helps

the preparation of better professionals. Another study that incorporates creative processes and tools (Manolis & Manoli, 2021) in the sustainable development strategies of HEIs shows good results, which means that similar models can be transferred to other HEIs and begin to contribute to society.

This model promotes collaboration between all stakeholders, and not only with experts in the field as usually occurs, as seen in the literature review section. This presents two main challenges. First, all participants should have the same level of information about the topic under study; this refers to the basic knowledge to be able to tackle the proposed challenge in an effective way. In addition, the sustainable development framework in which the co-creation process will take place must be previously established and shared. Second, the participation of diverse stakeholders, with different experiences in the field of study, can generate already known problems in vertical collaboration (between different levels of the decision pyramid). The need to change the way we relate to each other, without underestimating the role of any actor due to their background or the social stratum to which they belong (Sierra-Pérez & López-Forniés, 2020b), is paramount.

Although this co-creation model has been designed for application in HEIs, it can be used in other areas of society. However, whereas the university has its own specific environment where the profile of participants is quite similar, when the model is open to a general public it may be necessary to make some adaptations to solve particular problems faced by a specific community. As we have mentioned in connection with the existing problems of collaborative processes, the heterogeneity of the group will increase the difficulty of the challenges.

The model points the way to a better understanding of the complexity of the challenges that the community faces, and provides the means to propose solutions and encourage those with a good disposition to change their daily habits (Selvfors et al., 2019). In this regard, the identification of existing barriers in society for a sustainable lifestyle, which affect the commitment to the possible solutions generated by the co-creation process, should be addressed previously. These barriers are related to the behavior of the user and their values, knowledge or awareness of the challenge of sustainable development (Sierra-Pérez et al., 2021).

6. Conclusions

The proposed co-creation model for Sustainable Development in Higher Education Institutions is a hybridization of co-creation methodologies. Ethnographic techniques enable us to obtain information and an insight into the needs and habits of the different profiles of a community, to later comply with the terms of SDG 12: Responsible Production and Consumption.

The importance of focusing on higher education management lies in the fact that some institutions are large enough to be an example for the entire university community through activities and the development of sustainable policies, where the involvement of design tools to complete the model is primordial to achieve engagement and participation.

According to the results obtained, we conclude that an easy-to-use and well-adapted co-creation tool provides a suitable environment for the collaboration of different participants. This factor has been identified as crucial, since their different profiles allow them to be involved in a multidisciplinary group. Therefore, active participation is promoted, and the results are more likely to be of interest to the community, so that participants can be part of the solution. Leaving aside the differences of the participants within the HEI, the stakeholders must have free communication among themselves during each phase, which is encouraged by the co-creative processes and tools incorporated in the model oriented towards more democratic solutions. We also see the importance of

dealing with specific sustainability challenges such as the SDGs in HEIs, since providing tools that address them increases the possibilities that students will solve problems outside HEIs once they have graduated.

Based on the proposed co-creation model, some challenges need to be addressed in future research. As noted above, the extrapolation of the model to more general contexts in society will require new approaches to joint working between different groups of stakeholders involved. This will allow adequate vertical collaboration in order to maximize the quality of results. Furthermore, it will be necessary to identify the specific barriers in society to the adoption of sustainable lifestyle patterns in each of the areas under study, considering these in the commitment phase proposed in the model.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Electronic supplementary material

S1. Graphics showing the questionnaire applied in Phase 1: Profile and habits recognition, with its answers

S2. Results of the questionnaire applied through social media

Declaration of Competing Interest

There are no competing interests to declare.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.spc.2021.06.009](https://doi.org/10.1016/j.spc.2021.06.009).

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