



Mapping the Concept of Sustainable Consumption: An Analysis From the Adoption and Promotion of Pro-Environmental and Social Behaviors in University Students

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The concept of sustainable consumption has been described in the literature from different perspectives, but few have focused on defining the consumer perspective and strategies to appropriate this knowledge and behaviors in the classroom, which becomes a major challenge in times of Covid 19 and confinement. This article proposes an approach to the concept by university students from the implementation of a pedagogical strategy, which involved the implementation of a virtual learning community and the evaluation of the understanding of this concept through the use of mind maps (pre and post). Through the mind maps, data were collected to evaluate the understanding of the concept, the analysis of semantic richness and systemic complexity. The results show the associations established by the students, proposing a categorization system arising from the data and the previous literature review. The study concludes that the students broadened their vision of sustainable consumption in terms of the actors involved, consumption decisions and the social and environmental dimensions of sustainability.

Keywords: sustainable consumption, pro-environmental behaviors, mental maps, virtual communities, active learning, education for sustainable consumption (ESC), COVID-19

INTRODUCTION

Conventional consumption patterns have exceeded the capacity of natural resources, creating pressure on the limits of the environment. Therefore, the adoption of better consumption patterns becomes fundamental in the achievement of the social, economic, and environmental well-being that sustainability seeks. In this sense, it is necessary to find methodologies to educate children and young people so they can become consumers who are aware of the impact of their decisions on society and the environment. Sustainable consumption emerges as the concept that frames these new patterns and relationships between products, services, and consumers.

Prior research on sustainable consumption has been aimed at understanding current patterns and practices, as well as the factors for achieving it (Lorek et al., 2015). A lot of studies have looked at sustainability from the perspective of the consumer to understand sustainable consumption from the individuals' experience (e.g. Frank and Stanszus, 2019; Hanss and Böhm, 2012). This understanding is a fundamental starting point for education strategies that seek to promote this type of consumption.

In this context, this paper is devoted to a specific challenge: to find ways to assess the understanding of this knowledge in virtual learning environments that respond to the new forms of teaching pressured by the emergence of Covid 19. This study proposes an approach to the concept of sustainable consumption based on students' own experiences and assessing their understanding through the use of mind maps from the development of virtual learning communities.

The Concept of Sustainable Consumption

From the inception of sustainable development, sustainable consumption has been defined as “the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations” (Oslo Symposium on Sustainable Consumption-Norwegian Ministry of the Environment, 1994).

Going forward, references to the concept of sustainable consumption have pointed out a broader perspective that moves from a weak version of the construct (focused on minor changes that maintain the status quo of consumption patterns) to another more strong view that involves structural changes towards sustainable consumption (Fuchs and Lorek, 2005). In the context of this study, we will focus on all the individual actions that satisfy needs in the various areas of life, through the acquisition, use, and disposal of goods and services which do not compromise the ecological and socioeconomic conditions of all people (current and future generations). Recent literature links it to the support of societal well-being and embeds it into the greater concept of sustainable lifestyles, defined as “a cluster of habits and patterns of behavior embedded in society and facilitated by institutions, norms, and infrastructures that frame individual choice, to minimize the use of natural resources and generation of wastes while supporting fairness and prosperity for all” (Akenji and Chen, 2016, p. 3). Even though several definitions have been considered until now, all the literature agrees that there is no single and explicit definition of sustainable consumption, as it is a complex and multifaceted concept that involves different elements and perspectives on what sustainability is. In fact, the evolution of the concept from the Oslo Symposium until today, evidence of multiple factors, models, and domains approaching to explain and define sustainable consumption (Liu et al., 2017). One of these perspectives used to understand sustainable consumption stems from the adoption of pro-environmental and social behaviors.

Sustainable Consumption From Pro-environmental and Social Behaviors

As the main agent who makes consumption-related decisions, the individual has been the main focus of the analysis of sustainable consumption. Indeed, consumer behavior is one of the key topical issues addressed by research on sustainable consumption between 1995 and 2014 (Liu et al., 2017). For this reason, the achievement of this type of consumption has been associated with consumers adopting behaviors that have

a lesser impact on the environment and produce greater well-being to society (Geiger et al., 2018).

Some approaches have focused on analyzing and promoting behaviors aimed at the acquisition of products and services that reduce the environmental problems associated with conventional production and consumption activities, without losing their economic viability (i.e., the purchase of sustainable products) (Hanss and Böhm, 2012). This perspective, also called green consumerism, refers to the “production, promotion and preferential consumption of goods and services on the basis of their pro-environmental claims” (Akenji, 2014, p. 13). Such perspective may be considered as an initial, but the narrow approach of sustainable consumption. However, as the various impacts that a product can generate in the environment go beyond its production processes, it is necessary to understand consumption beyond the act of choosing products or services with sustainable characteristics. For example, different life cycle analyses of products have shown that, for many of them, the greatest impact is found in the use and handling of the consumer once they have been purchased (e.g., Levi Strauss and Co, 2015). Moreover, to reduce the pressures on natural resources and the waste from production and consumption, even less consumption is needed (Akenji, 2014). Hence, a broader perspective on sustainable consumption does not only connect behaviors related to purchasing decisions but also those related to all the individual decisions that could harm the environment, including choices on the use and disposal of the product at the end of its useful life (Peattie and Collins, 2009; Geiger et al., 2018). For instance, Akenji and Chen (2016) refer to new frameworks like such of Refuse, Effuse and Diffuse -REDuse that encourages behavioral changes targeting an ample spectre of decisions under a sustainable lifestyle. First, it is imperative to discourage harmful choices to nature (i.e., Refuse) (e.g., reduction of food waste); then it is important to promote positive behavioral practices (i.g. Effuse) (e.g., the use of alternative means to commute instead of private cars); finally, it is needed goes beyond each individual and reach out collective sustainable behaviors (i.e., Diffuse) (e.g., sharing or collaborative consumption like carpooling).

Although many of the approaches towards sustainable consumption limit themselves to a concept associated exclusively with the environmental dimension of sustainability (Thornton, 2009; World Resources Institute, 2005) (e.g., analyzing behaviors that aim to create a better environmental impact) (Roberts, 1996) a broader perspective involves the interaction of social and environmental problems (e.g., environmental protection, inter and intra-generational equity, and quality of life, among others) (Pepper et al., 2009). Because the social impacts of consumption can be equally problematic than environmental effects (Akenji and Chen, 2016), a broader perspective of sustainable consumption also addresses factors that influence socially conscious consumer behavior; this is, behavior that seeks to have a better impact on people (e.g., labor rights and working conditions, business impact in the communities in which they operate, among others) (Pepper et al., 2009; Straughan and Roberts, 1999). In this way, sustainable consumption, as seen from the point of view of

behavioral changes, links decisions inspired by both social and environmental issues, along with lifestyle changes that reflect personal values and seek quality of life (Peattie and Collins, 2009).

Learning and Teaching Sustainable Consumption

Consumption has become a fundamental topic within the pedagogical discourse towards sustainability (Barth et al., 2014) and education has been described as “one of the most powerful tools for providing individuals with the appropriate skills and competencies to become sustainable consumers” (Khalili et al., 2008, p. 25). This means that education, beyond the transmission of knowledge aimed towards achieving sustainable consumption, should seek the development of key competencies that enable individuals to appropriate this concept and then connect it to their own lifestyles (Barth et al., 2014). Because of this, higher education, as a fundamental actor in the Education for Sustainable Consumption (ESC) (Barth et al., 2014), must link the action of learners and propose, through pedagogical strategies, the appropriation of concepts taken from the student’s own experience (i.e., active learning) (Rieckmann, 2018).

Although a variety of pedagogical strategies have taken up the challenge of active learning, many of them have focused on the development of classroom activities. However, key competencies for learning about sustainable development and consumption such as the capacity for critical and systemic thinking and the exploration of the contradictions and challenges inherent to a more sustainable life (Vare and Scott, 2007), not only take place inside the classroom but also outside it. The present study shares this perspective, in which informal learning processes that take place in daily life experiences over a variety of spaces can be useful in developing such competencies (Barth et al., 2014). Although from the theory it is possible to identify guidelines for approaching the understanding of sustainable consumption and then promoting its adoption, this work proposes an alternative way, seldom explored, to achieve an approach to the concept outside of class, using the students’ own experiences as consumers who are trying to adopt pro-environmental and social behaviors, and from their contact with initiatives that other actors are taking to promote it (e.g., companies, industries, governments.)

Active Learning Beyond the Classroom

The OCDE has proposed various skills and competencies to approach the 21st century, described as “the skills and competencies required to be effective workers and citizens in a knowledge-based society of the 21st century” (Ananiadou and Claro, 2009, p. 5). These address complex issues such as computing, communication, ethics, and social impact. In this same sense, the UNESCO (UIE, 1997) developed the concept of “lifelong learning,” which addresses four pillars of learning: learning to know, learning to do, learning to be, and learning to live together. This framework suggests finding learning models that fit this context, which involves developing these competencies and skills throughout life.

Learning, as a social construction of meanings through communication models, needs the collaboration between peers

(Gairín Sallán and Muñoz, 2006). This collaboration could be developed not only in the classroom, but also in virtual environments. Moreover, following the United Nations Guidelines for Education towards Sustainable Development (ESD), an active learning is focused on action, in which the student is considered an autonomous agent capable of developing knowledge, attitudes, and values from his/her own experience and reflection. Thus, this study, implemented a pedagogical strategy in which an active learning is promoted through the experience of each individual as a consumer and the interaction of students in a virtual environment.

In this sense, the postulates of the constructivist theories of knowledge become important, as they consider doing as the proper learning tool, capable of modifying the cognitive structures of the learner. These theories state that the act of learning only occurs when there the learner has an imbalance, which results in rebuilding their networks of meaning and the reconstruction of their cognitive structure, in which the most relevant factor of learning are the preconceptions the learning subject has already incorporated and their ability to map the new knowledge. Craik (2020) suggests that recall is the result of the interaction between the new information that enters and the interpretation of events or information from the past and that this is the basis of learning.

Ausubel (1960) father of the Meaningful Learning Theory, starts from the assumption that knowledge is modeled when the student or learner assigns a meaning, makes sense, or establishes a relationship with new concepts or previous experiences. This is, for the learning process to take place, new thoughts or information must be incorporated into pre-existing ones, and this is only achieved through experience. Lave and Wenger (2001) propose that the assignment of meaning to knowledge occurs as a social process of negotiation between knowing and doing and that this process stems from human experience. Several authors developed the notion of improving teaching in higher education through researching their own work, not only to acquire new knowledge but also as a way of evaluation (Altrichter and Posch, 2013; Angelo et al., 1993).

From these theories, we can conclude that every educational action must include a cognitive disturbance or motivation, a phase of rearrangement of cognitive structures, and a phase of appropriation of meanings, focusing the learning process on the elaboration of knowledge from the existing mental structures of the student. In this sense, considering that the modification of existing cognitive structures requires doing and that the application of various allow producing such modifications, with mind maps as one of those tools.

Knowledge Assessment Through the Use of Mind Maps

Teaching in higher education through student experiences must be understood not only from the perspective of appropriating knowledge but also from the evaluation (Altrichter and Posch, 2013; Angelo et al., 1993; Reiska et al., 2018). Mental schemas are an effective tool that allows evaluating or identifying changes in structures of meaning, as well as improving skills such as critical

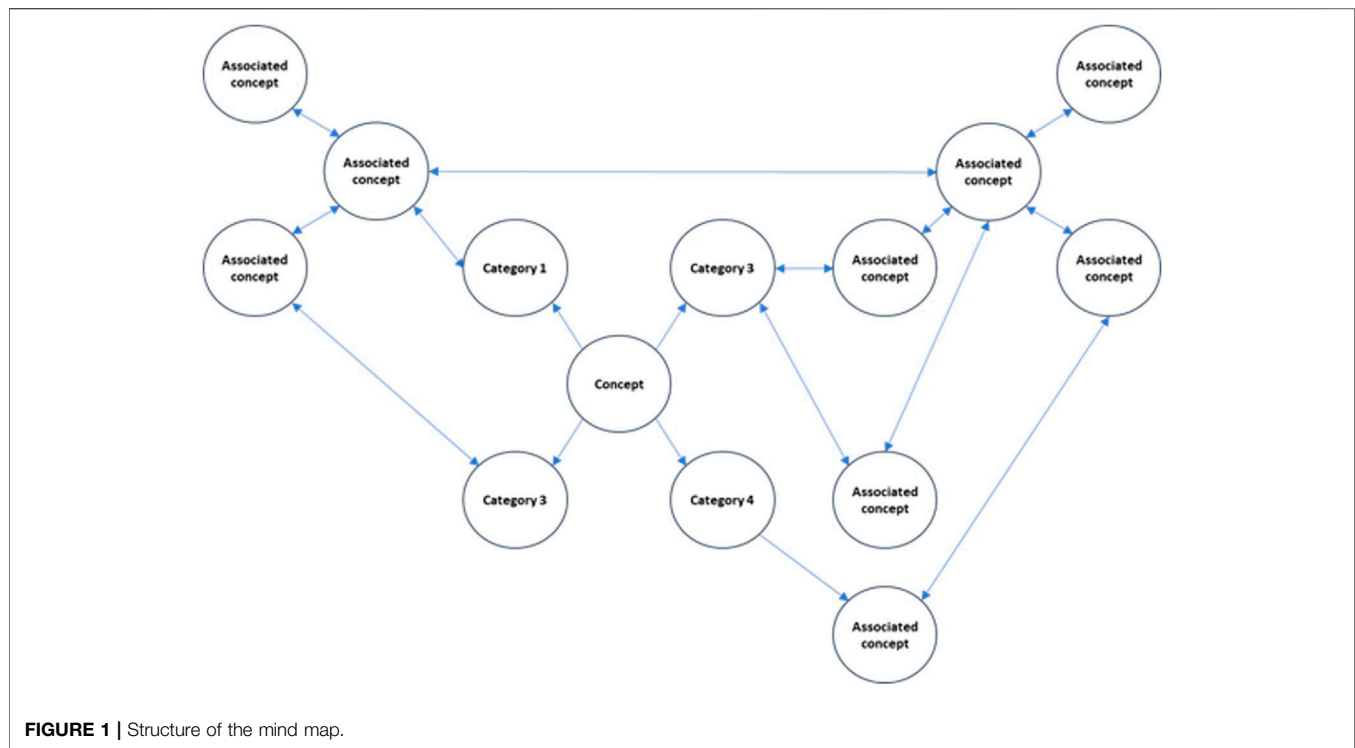


FIGURE 1 | Structure of the mind map.

thinking and decision-making and key competencies required to understand sustainability (Faham et al., 2017; Goy et al., 2017; Reiska et al., 2018).

Mental schemas can be defined as mental diagrams that represent reality in an organized way that allow ideas and concepts to be related. In the teaching and learning processes, the literature describes different types of schemas that allow this process to occur. Liu et al. (2014), establish that the low use of mental abilities is one of the most important problems in education and that the use of maps or mental schemas can contribute to boosting their use.

Novak and his team developed a type of schema called concept map to show changes or modifications in the understanding of concepts (Novak et al., 1988; Novak, 1990, 2010). On the other hand, Buzan, 1996 developed the concept of the mind map, which describes the development of a network of interconnected propositions in which notions and relationships stem from a central concept, creating a visual schema of the structures of thinking and the connections established by new structures. (Figure 1).

This technique is based on the understanding of brain function, radiant thinking, and the learning process. For the authors, radiant thinking is defined as the process by which the brain associates thoughts from a central connection and where the brain's ability to generate associations plays an important role. From the perspective of the stages of construction of knowledge, the construction of any type of mental schema becomes a knowledge tool or mental instrument that can have different levels of development.

Mind maps allow evaluating progressions in metacognition or the structuring of meanings in relation to certain concepts, while

also enabling to establish the degree of association of this knowledge with other concepts internalized previously. Several authors who worked around cognitive maps (Legrand, 2000; Pudelko and Basque, 2005; Berthou and Marchand, 2010; Gray et al., 2019) converge in stating that mind maps can vary in their general structure, the way they represent knowledge and how they represent relationships. Ontoria et al. (2003) discovered how university students improved several aspects through the use of mental maps, such as their disposition towards learning, the development of autonomy of thought, and self-perception. Mind maps can be considered as external representations of individual "mental models" held over a complex real-world system (Gray et al., 2019).

Mind Maps and the Evaluation of Learning About Sustainability

Mind maps have been used to evaluate learning associated with sustainability. Segalàs Coral (2009) analyzed the competencies that engineers need to acquire in relation to sustainability topics in higher education, evaluating these competencies through the application of cognitive maps in five European universities. Legrand (2000) assessed the students' knowledge of the environment through the use of mind maps, proposing an analysis through the maps semantics and systemics. Lourdel et al. (2007) used cognitive maps to represent the understanding of the concept of Sustainable Development in engineering students and raised the importance of this concept in the formation and reflection that must be part of this process. Watson et al. (2016), used this tool and compared it with surveys of the students, demonstrating that the wealth of knowledge acquired by the students can be evidenced better through the use of mind maps. Bonilla, 2018 used mind maps to measure the progression of the

concept of sustainable development in business administration students, using pre-test and post-test assessments in their analysis.

Cognition towards sustainability implies understanding the complicated relationships underlying the concept, as well as developing the necessary skills and competencies that enable students to face the challenges that sustainability entails. Gray et al. (2019) state that, although the development of systemic thinking is necessary to reflect on complex problems such as socio-environmental problems, there is still a gap in understanding the best ways to evaluate these skills in the classroom, and mind maps provide a way of showing the enrichment in the meaning structures of the students in a graphical way.

The confinement scenario proposed by the emergence of COVID-19 prompted changes in higher education, specifically aligned to virtual education and the use of digital tools (García-Morales et al., 2021). This reality highlighted the importance of developing strategies that allow teachers to assess the knowledge of their students in a different way. The literature evidences different learning methodologies such as the use of gamification or games in the classroom, the use of augmented reality (Loureiro et al., 2020), the use of applications in social networks, online conference platforms, and smartphones (Mishra et al., 2020). Likewise, different evaluation methodologies are evidenced, such as evaluations using video tags, self-assessments, interviews, and the diagnostic evaluation that uses as one of its tools the use of concept maps (García-Morales et al., 2021).

The use of concept maps is associated with a better structuring of bodies of knowledge and allows understanding the relationships and associations that students elaborate on them (Hayashi et al., 2020; Mandrikas, 2020), and its importance in confinement contexts is associated with the possibility of being done online (Fatawi et al., 2020).

MATERIALS AND METHODS

The research analyzes how university students modify their knowledge structures when faced with the concept of sustainable consumption, based on outside classroom experience the classroom, within the framework of an undergraduate course on business sustainability.

The methodology applied involves the appropriation of knowledge from the creation of a virtual learning community around the adoption and promotion of pro-environmental and social behaviors, as well as the evaluation of their pre and post knowledge using mind maps.

Description of the Learning Strategy

Objective of the Pedagogical Experience

From the basis of considering learning as a social construction of meanings through communication models mediated by peers through a collaboration between them (Gairín Sallán and Muñoz, 2006), the strategy implemented promoted the interaction of students in a virtual environment. Following the United Nations Guidelines for Education towards Sustainable Development (ESD), this strategy focused on learning through action, in which the student is considered an autonomous agent capable of developing

knowledge, attitudes, and values around sustainable consumption from their own experience and reflection. The activity was designed to promote the development of competencies, such as critical thinking, systemic thinking, and active learning, which are considered fundamental in ESD (Rieckmann, 2018).

Participants and Purpose of the Activity

“Towards Sustainable Consumption” was an activity in which 23 students were invited to participate in the creation of a virtual community. The participants were third-year undergraduate students in Business Administration at CESA, 52% female and 48% male, between 20 and 23 years of age. The virtual community had three purposes:

- 1) Assuming and understanding the role of the consumer in sustainability through the process of adopting pro-environmental and social behaviors.
- 2) Identifying the role of organizations in promoting sustainable consumption behaviors.
- 3) Promoting sustainable consumption through interaction and community generation.

Procedure

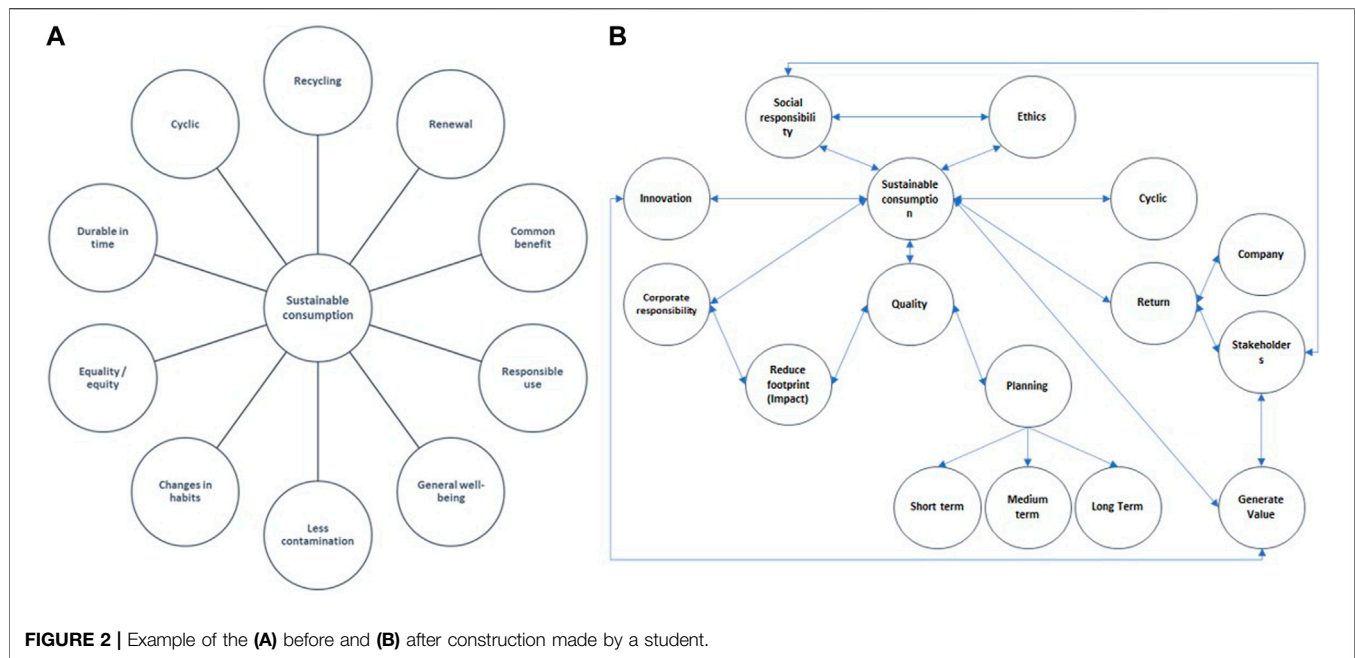
Start

The first phase of the activity had a duration of 1 week. It consisted of each student researching the definition of sustainable consumption and which behaviors could be linked to this type of consumption. Additionally, students measured their ecological footprint and, based on the result, identified behaviors in which they had the potential for improvement. In this way, the starting point consisted of the students researching the concept and measuring their footprint, in which they were tasked with selecting three behaviors and coming up with an action plan for their adoption in the following 6 weeks. For this purpose, students created a personal blog in which their first post included the results of the first phase, and then it would serve to report their progress over the following 6 weeks on the road to more sustainable consumption.

Development

The second phase of the activity had a duration of 6 weeks, in which the students worked on the three behaviors they selected. Every week, each student made a post on their blog, addressing three dimensions of the behaviors on which they worked.

- 1) An experience report answered the following question: How is your experience adopting these behaviors in your daily routine? Faced with this question, each student could report positive and negative aspects of their experience (e.g., people who supported the process, elements that facilitated and motivated adoption, difficulties they faced) as well as their progress in the action plan they drew up at the beginning of the activity (e.g., activities carried out, adjustments, and necessary changes in their objectives, and compliance.)
- 2) Doing research that answered the following question: What are companies and organizations doing to promote these behaviors? Students answered this question by identifying initiatives, campaigns, programs, and news that made it



possible to demonstrate the organizations' efforts to promote sustainable consumption.

- 3) A conclusion that answered the following question: What is your point of view about these sustainable consumption behaviors? Based on their own experience and the experience of other people trying to adopt these behaviors (their classmates), as well as the organizations' management they identified, students proposed their vision of sustainable consumption and its related behaviors.

Appendix A shows a) the publication/post model with the three dimensions, and b) an example of a publication/post made by the students.

For the development phase, in addition to creating their own post/publication creatively, linking resources that support the content (e.g., links, images, and videos), students interacted and generated community through comments, recommendations, questions, and other types of interactions in their classmates' blogs. According to Gairín Sallán and Muñoz (2006), the permanent interaction around "themes or units of meaning" can denote a high learning potential. Furthermore, interactivity and dialogue among peers are key elements that promote knowledge through the network (LaPointe and Gunawardena, 2004). Following these perspectives, during the activity, the students had to review the blogs of at least three classmates every week and comment on their posts. Comments were required to be a contribution to the topic (the adoption of sustainable consumption behaviors). For example, they could contribute through advice on adopting this type of behavior, posting links to websites and videos with useful information about them, as well as recommendations to overcome difficulties they identified and references to organizations' management that could be useful further linking these behaviors in their daily routines, among others.

Also, the students were motivated to generate a community around their blog by inviting their classmates and other reference groups (e.g., friends and family) to participate and comment on their blog. All the activity was implemented in Blogger, a service run by Google, due to its ease of use and access to create and publish content, as well as to interact online.

The Context: COVID-19 Pandemic

The activity was developed during the initial phases of the COVID-19 pandemic. The purpose of this study was not to analyze the effect of this context on the adoption of pro-environmental and social behaviors. However, it is important to acknowledge that there could be implications of the context in the activity. For example, although some students chose to commute through alternative means of transportation instead of using private cars, as a targeted pro-environmental behavior, the restrictions in mobility did not allow them to advance towards this goal. Thus, some behaviors could emerge, and others could be dropped due to the confinement. The place attachment to the home and the consequent change in habits and behaviors (e.g., embracing the use of technology for shopping, acknowledging the importance of saving water and energy, the awareness of waste) may also trigger some pro-environmental and social practices.

Creation of Mind Maps as a Learning Assessment Strategy

Students created two mental maps to assess their appropriation of the concept of sustainable consumption and identify changes in learning the concept, one before and one after developing the activity "Towards sustainable consumption" (pre and post): the first map was created before receiving the instructions and explanation about the activity that would take place over the following 7 weeks (1 week

for the start and 6 weeks of development). The second mind map was created at the end of the activity.

In both measurements (pre and post), the students were instructed to make a mental map in which they reflected on what they understood and associated with the concept of sustainable consumption. They were reminded that every mind map has the core concept at the center and that they could write related words (not phrases or descriptions) to it, linking these words with the core concept and with each other using arrows.

Students were tasked with capturing whatever they had in mind about the concept; this is, without resorting to any external source of information about the subject. **Figure 2** represents an example of the before and after construction made by a student.

Data Analysis Strategy

In the analysis, we considered the mental maps constructed by the students' pre- and post-implementation of the virtual learning community. Following the proposal of Legrand (2000), the appropriation of the concept of sustainable consumption was evaluated through an analysis from the semantic and systemic richness (i.e., complexity) of the maps. The maps were analyzed individually and in groups, to understand the students' progress in understanding their meaning structures.

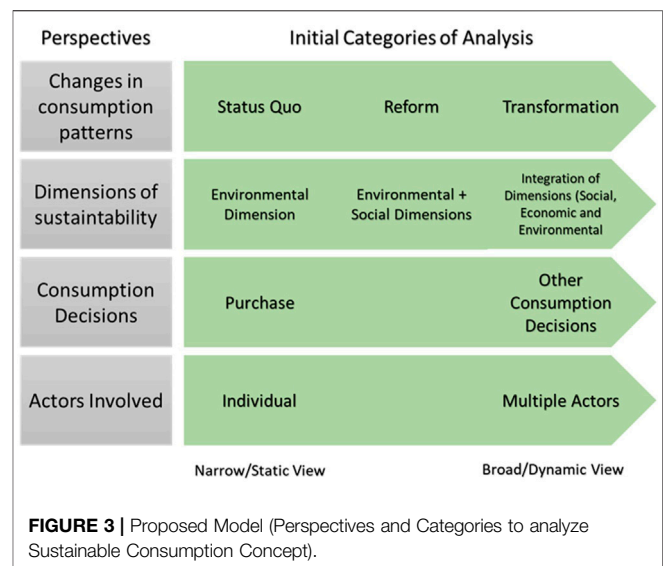
Analysis Through Semantic Richness

Semantic richness is understood as the number of concepts associated with each of the categories, defined conceptually from a theoretical perspective. Following Neuendorf's conventional content analysis (Neuendorf, 2016), we identified the initial semantic units (concepts), classifying them in terms of similarities and differences, and defined subcategories from this classification. These subcategories were then reviewed, compared, and grouped based on the elements defined for each category or primary dimension. This grouping allowed us to calculate frequencies by counting the concepts and interconnections in the students' mental maps.

The precision of the findings was evaluated using the credibility, trust-ability, and transferability criteria proposed by Guba and Lincoln (Lincoln and Guba, 1986). The credibility criterion was achieved through prolonged and guided follow-up for data collection and analysis. The trust criterion was achieved through feedback and monitoring by experts on the subject and careful tracking of each step in the collection and analysis of information. Finally, to ensure transferability, a complete description of the categories, characteristics of the participants, methods of data collection and analysis was provided.

Category Analysis Model

The construction of categories considered various perspectives from which the prior literature has addressed the concept of sustainable consumption. Although there is no theoretical approach yet to provide a structure to these perspectives, the present study proposes an analysis model in which the concept is appropriated from four main perspectives: the actors involved, consumption decisions, dimensions of sustainability, and the magnitude of changes in consumption patterns. Additionally, the analysis model establishes in each perspective categories of analysis that are located at the endpoints of a continuum and serve to account for the vision of sustainable consumption, ranging from



narrow and somewhat static views of the concept to broader and more dynamic views that link more elements and seek to provide greater scope to sustainable consumption. **Figure 3** shows the proposed model with the analysis categories. **Table 1** shows the description of each perspective.

Systemic Complexity Analysis

The complexity indicator (CO) assesses how students enrich and connect concepts related to sustainable consumption (Segalàs et al., 2008; Watson et al., 2016). These two indicators are evaluated before and after students applied the didactic experience. To obtain this value, two factors are multiplied:

$$CO = NC * LCa$$

where:

NC is the average number of concepts per student for each category established from the theory and LCa is a standardized measure from the connections, the categories and relative weight of each of them. Normalized by the number of categories and the number of students and is therefore calculated as follows:

$$Ninte + cat/Ncat * Ns$$

In the learning process, this becomes a tool that enables understanding the radiant thinking that the student has constructed around the concept of sustainable consumption, based on their experience, observation, and analysis of cases, and their work in the classroom. The **Table 2** shows the metrics used:

RESULTS

The implementation of virtual learning communities allowed students to explore actively and begin to understand the concept of Sustainable Consumption and to structure it based on understanding reality (this is, from their own experience and organizations' management.). The results of the evaluation of the

TABLE 1 | Description of the analysis perspectives and visions of sustainable consumption.

Perspectives from which sustainable consumption has been approached	Narrow view	Broad view
Actors Involved	<p>Considers the individual as the main agent of sustainable consumption Evans and Leighton (1989), Maniates (2001)</p> <p>Assigns a burden and contradictory role to the individual: maintaining economic growth while driving the system towards sustainable models Akenji (2014)</p> <p>—</p> <p>—</p>	<p>Presents a systemic perspective in which different actors and aspects are involved in achieving true change Lorek et al. (2015), Vergragt et al. (2014)</p> <p>Consumption behavioral changes are dependent on consumer plus on highly interdependent sociotechnical networks or systems of provision, including several actors in the value chain, regulators, and other stakeholders as well, like NGOs^[1] and IGOs^[2] Akenji (2014), Chappells and Shove (2005), Fuchs and Lorek (2005)</p> <p>^[1] Non-Governmental Organizations ^[2] International Governmental Organizations</p>
Consumption Decisions	<p>Focus on purchase decisions: Analyzes and promotes the acquisition of products and services that reduce social and environmental problems Hanss and Böhm (2012). It is related to green consumerism which is a market-driven approach focused on keeping the acquisition of products but preventing the most damaging and immediate environmental problems Akenji (2014)</p>	<p>Points out that the impacts that a product can generate in the environment go beyond its production processes, but also involves its use and handling by the consumer and its disposition at the end of its useful life. Peattie and Collins (2009)</p> <p>Through frameworks centered on everyday sustainable actions, considers all the individual and collective decisions that may have a social and environmental impact (e.g., Refuse, Effuse and Diffuse (REDuse framework) Akenji and Chen (2016)</p>
Dimensions of Sustainability	<p>Sustainable consumption is exclusively associated with the environmental dimension of sustainability World Resources Institute (2005), Thornton (2009)</p>	<p>Sustainable consumption involves concern and interest in the interaction of social and environmental problems Pepper et al. (2009), Straughan and Roberts (1999), Toffel (2003)</p> <p>The ideal of a broad vision of sustainable consumption would integrate the three dimensions of sustainability (environmental, social, and economic.) It involves the perspective of the political economy of consumption (environmental, social, and economic issues addressed under the same framework) Cohen et al. (2013)</p>
Changes in Consumption Patterns	<p>Maintaining the status quo: small changes that maintain current patterns of development, consumption, and lifestyle, but striving for these to have less impact on the environment Hopwood et al. (2005)</p> <p>Approaches based on technology to achieve eco-efficiency in goods and services, keeping a view of pro-economic growth. Schmidheiny (1993). Also called a weak version of sustainable consumption Fuchs and Lorek (2005)</p> <p>—</p>	<p>Reform: They address new ways to fulfill needs, to do business, and organize society in a sustainable way. Focused on the understanding of consumption's drivers and on intervening at a preventive level Akenji (2014)</p> <p>Transformation: they seek to change societies and economies in a deeper and more systemic way, in which all elements are structured towards sustainability Hopwood et al. (2005), Peattie and Collins (2009)</p> <p>Involves structural changes in the system, which are needed to achieve sustainable development. Akenji (2014). Also called a strong version of sustainable consumption Fuchs and Lorek (2005)</p>

TABLE 2 | Metrics used in the complexity index.

Abbreviation	Definition
CO	Complexity indicator
NC	Average number of concepts per student for each category established from the theory
LCa	Standardized measure from the connections, the categories and relative weight of each of them
Ninte + cat	The sum of all links or interactions in each category
Ncat	Number of categories
Ns	Number of students

Note: Adapted from (Segalàs et al., 2008; Watson et al., 2016).

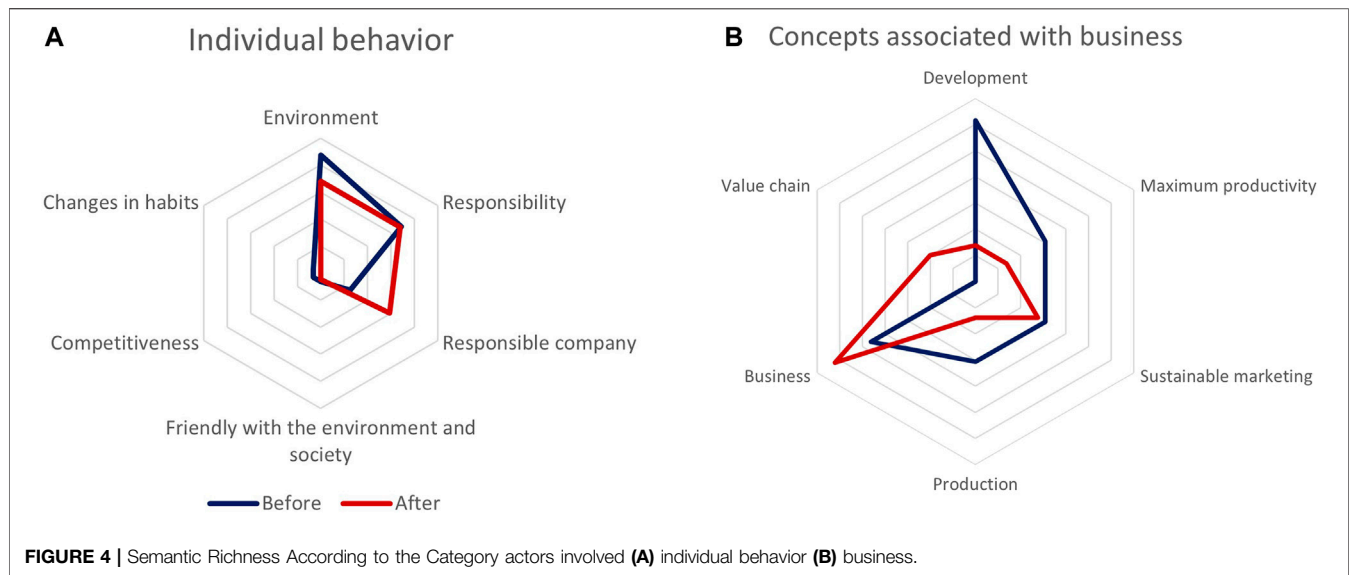
mental maps before and after the experience show the following results:

Semantic Richness

Relevance of Concepts Related to Sustainable Consumption

The relevance of concepts related to sustainable consumption was compared between the mind maps before and after the activity. In

general, a greater number of concepts associated by the students to sustainable consumption is evidenced, 170 terms in the pre-activity maps while in the post-activity mind maps a total of 259 units of meaning (number of concepts mentioned by the students) associated with sustainable consumption was evidenced. This describes the diversity of interpretations and approaches around it. This coincides with our findings in the literature. Among the results, the inclusion of concepts related to



culture, value chain, technology, and continuous improvement stands out. The terms culture, responsible society, and responsibility, in general, accounted for 18% of the mentions, opening the door to understanding sustainable consumption beyond an exclusively environmental dimension. In addition, a concrete element that emerged in the results is the relationship of the concept of sustainable consumption with the SDGs (Sustainable Development Goals).

When grouping the topics in each of the categories proposed from the literature, it is evident that in the results after the activity the students were able to identify a greater relevance of the role of the actors (36%) and the dimensions of sustainability (39%), especially the social dimension. On the other part, the concepts associated with the category of Consumption Decisions decreased, although they are still closely linked to the concept of recycling, which can be explained by the relevance that the students found in other aspects of consumption, not only from the point of view of final waste disposal and recycling.

Based on the proposed analysis model, the concepts associated with sustainable consumption were reviewed before and after the application of the pedagogical strategy. The evolution of the concept is presented below, from the four perspectives that emerged from the theory: actors involved, consumption decisions, dimensions of sustainability, and magnitude of changes in consumption patterns.

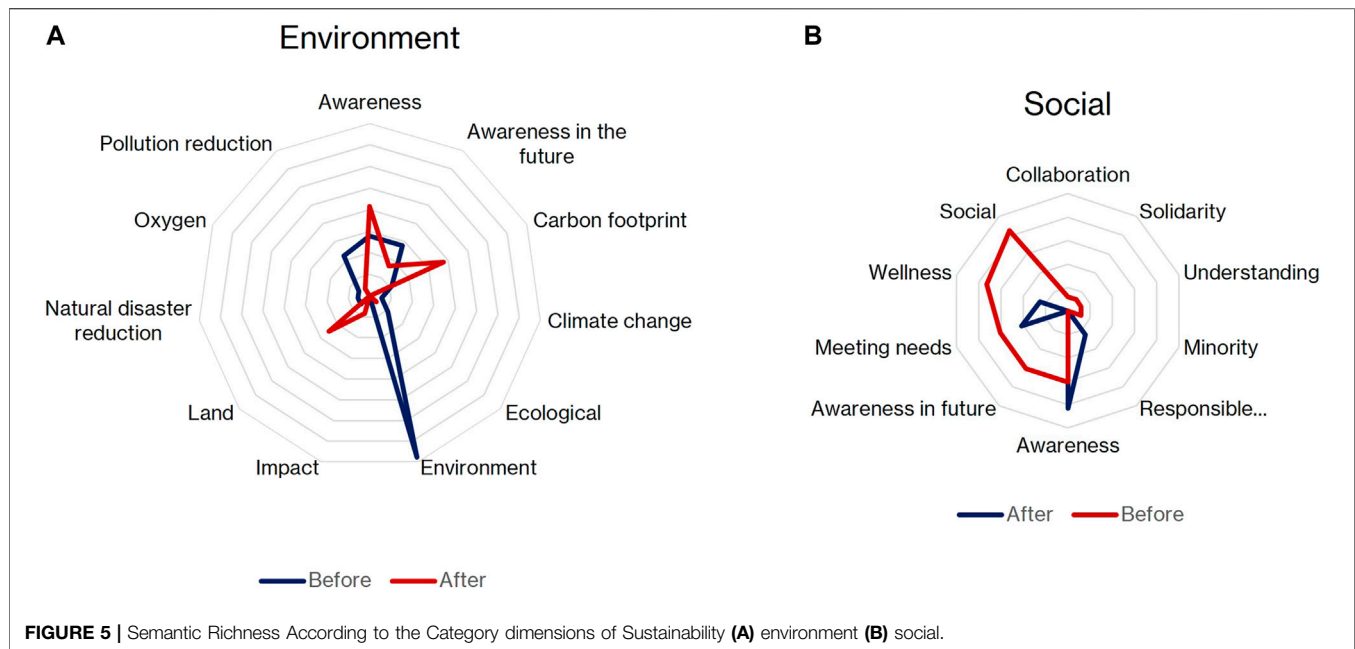
- Actors involved** (companies, individuals, and the government): The pre and post-activity maps associate the concept of independent responsibility of a specific actor. However, in the pre-maps, responsibility is associated with company management (efficiency, development, and production) and processes and operations (sustainable marketing, clean energy, and the value chain or supply chain management). After 6 weeks of adopting sustainable consumption behaviors, the

participants placed the responsibility on individuals, citing “responsible society” as one of the concepts most associated with sustainable consumption. On the other hand, when analyzing the initiatives of organizations, the understanding of the concept of sustainable consumption in terms of management performed by companies (technology, value chain, and continuous improvement) and topics such as clean energy, customers, sustainable marketing, and added value are still relevant. The role of the Government as an actor (pre and post-activity) was associated with issues such as poverty reduction, policies, infrastructure, and regulation. (Figure 4).

- Consumption Decisions:** The maps analyzed show that the concepts in this category are associated with use (e.g., proper use of resources, life cycle, continuous improvement, clean energy, efficiency, and savings) and with the final disposal of the product, identified with “recycling.” Possibly, recycling was one of the behaviors that most participants adopted during the experience, which led to this consumption decision being clearly associated with the concept of sustainable consumption. (Table 3).

TABLE 3 | Description of the concepts associated with Consumption Decisions.

	Purchase (%)		Use (%)		Disposal (%)	
	Before	After	Before	After	Before	After
Good use of resources	64, 71	81, 0	29, 7	48, 6	0, 0	0, 0
Recycling	0	0, 0	0, 0	0, 0	100, 0	56, 5
Good waste management	0	0, 0	0, 0	0, 0	0, 0	21, 7
Lifecycle	0	0, 0	21, 6	14, 3	0, 0	21, 7
Efficiency	0	0, 0	8, 1	8, 6	0, 0	0, 0
Clean energies	0	0, 0	13, 5	8, 6	0, 0	0, 0
Duration and use	0	0, 0	0, 0	8, 6	0, 0	0, 0
Saving	0	9, 5	5, 4	5, 7	0, 0	0, 0
Raw material	29, 4	0, 0	0, 0	0, 0	0, 0	0



- Dimensions of Sustainability:** Pre- and post-activity maps associate sustainable consumption with the environmental dimension (concepts such as the environment, pollution reduction, and ecological and carbon footprint are associated.) The social dimension takes relevance in the post-activity results through the concept of culture. Furthermore, the social concepts of well-being and satisfaction of needs are present in both moments. However, even when the economic factor is considered in the comprehensiveness of the dimensions, sustainable consumption was not closely associated with this dimension, with few specific mentions of the “orange economy” and “sales.” (Figure 5)
- The magnitude of changes in consumption patterns:** Although this perspective was more challenging to identify, results suggest the relationship of the concept to maintaining current consumption patterns (i.e., the status quo) but with better use of sometimes limited and regulated resources, in addition to the use of technologies to achieve sustainability (clean energy, efficiency, limitations, and regulation.) On the other end, the few mentions associated with transformation, renewal, and cycles indicate a low level of understanding about the need for significant change in consumption patterns. (Figure 6).

Systemic Complexity

Systemic Complexity is understood as the degree of connection that students achieve between concepts. For its measurement, the complexity index was used (see section 2.3.2).

$$CO = NC * LCa$$

These interactions indicate the construction of complex thought that emerges as a result of understanding sustainable consumption as an interdependent system. (Table 4).

Complexity in this study should be understood from the development of complex thinking based on the degree of association that students achieve between concepts and categories related to sustainable consumption.

The results in relation to the complexity indicator show a progression in the degree of interactions before and after the instruction by the students.

It also evidences the significant increase obtained after the training in the category of stakeholders and changes in consumption behavior patterns. However, the relationship of sustainability in general to the vision of the dimensions is still very strong.

DISCUSSION AND CONCLUSION

This research shows the appropriation of the concept of sustainable consumption through the application of a pedagogical strategy of active learning outside the classroom. This strategy motivated the participants to adopt pro-environmental and social behaviors, as well as to explore and identify organizational initiatives that promote this type of behavior. The pedagogical activity included a sequence of stages around the conceptualization of sustainable consumption: as a starting point the students made an initial approximation to their understanding of sustainable consumption through a mind map; then, they initiated a plan to adopt pro-environmental and social behaviors, based on their

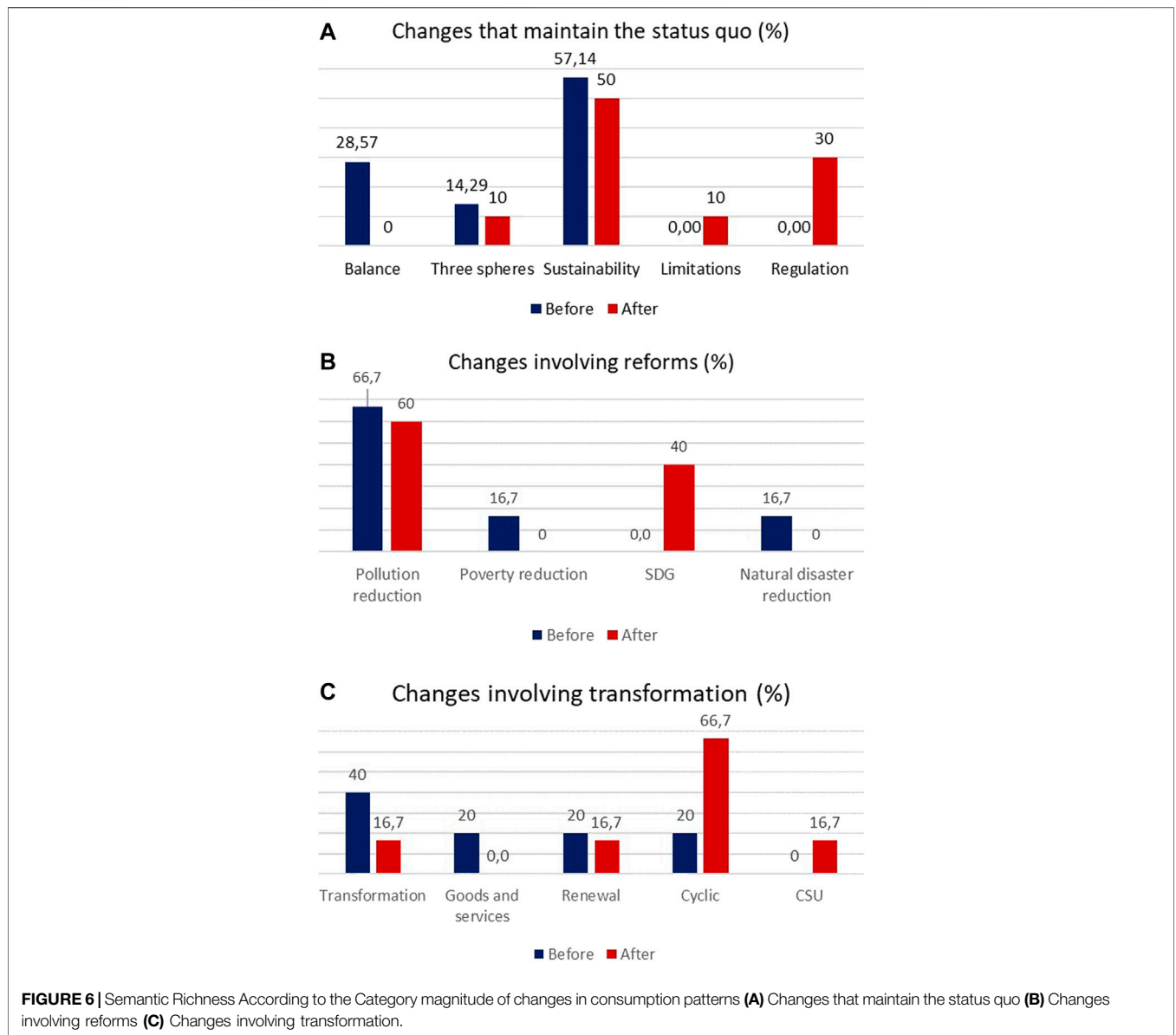


TABLE 4 | Systemic complexity.

Perspectives	Sample		NC		LCa		CO	
	Before	After	Before	After	Before	After	Before	After
Actors involved	56	116	2, 43	5, 04	0, 61	1, 3	1, 48	6, 35
Consumption Decisions	79	93	3, 43	4, 04	0, 86	1, 0	2, 95	4, 08
Dimensions of sustainability	84	117	3, 65	5, 08	0, 91	1, 3	3, 33	6, 46
Changes in consumption patterns	10	18	0, 43	0, 78	0, 11	0, 2	0, 05	0, 15

footprint, and reporting this experience, joined to what organizations did to promote the behaviors of interest, in a personal blog; this phase involved interaction and community as a collaborative learning thanks to the comments and recommendations in classmates' blogs. At the end of the

activity, they went back to the creation of a mental map to express their appropriation and understanding of the concept.

The target group of this pedagogical intervention was a small sample of third-year undergraduate students in Business Administration. We acknowledge a limitation of this research

in the size of the sample. Although it was carried out with 23 participants, these correspond to the total number of students in the course in which we focused the activity. However, we consider that being an exploratory study allows us to analyze the appropriation of the concept in students. We hope to reach a larger sample in future related research.

After an evaluation through the use of cognitive maps, the results display an atomized concept of sustainable consumption, with various mentions pointing to multiple categories. This confirms the complex and multifaceted character of the concept of sustainable consumption found in existing literature [1]. One of the contributions of this research is to make a first exercise of organizing the multiple perspectives from which sustainable consumption has been analyzed. We did it proposing a model that enables us to identify: 1) The broadness of the existing vision around the concept of sustainable consumption, and 2) How learning, from the student's personal experience, can produce changes in this vision.

The proposed analysis model identified four main perspectives from which sustainable consumption has been addressed: the actors involved, consumption decisions, the dimensions of sustainability, and the magnitude of changes in consumption patterns. The evaluation through mental maps allowed us to identify a progression in the structure of meanings related to the concept of sustainable consumption. From the proposed categorization model, this structure allows us to suggest that the students' vision of sustainable consumption is located in a spectrum that moves between a narrow vision is linked to a single actor, a consumption decision, and a dimension of sustainability, and the other end that consists in the ideal broad vision in which multiple actors, consumption decisions, and dimensions of sustainability are integrated into the description of sustainable consumption.

The active learning experience produced important changes in the development of the concept of sustainable consumption. Making the students approach reality by assuming their role as consumers, together with their own research on what organizations are doing to promote sustainable consumption patterns, led them to:

First, broaden their vision of the actors involved in sustainable consumption. Although students involved actors beyond the individual in both moments (before and after the activity), the experience adopting pro-environmental and social behaviors awakened in them a kind of commitment that led them to assigning the individual a greater responsibility. Though from previous literature, the individual has been the salient agent in the production-consumption system (Akenji, 2014) it seems that students attributed the responsibility of sustainable consumption to other actors (e.g., companies and government); however, after assuming the role as a consumer adopting sustainable behaviors, they realized the role of individuals in sustainable consumption. Probably, policies and strategies to encourage sustainable consumption have focused the attention on individuals, sometimes assigning a double burden to consume more while drive other actors (e.g., Companies and Governments) towards sustainability (Akenji, 2014). However,

from the consumer perspective, there are different actors, including individuals, who should be related to the concept of sustainable consumption.

Second, achieve an understanding of sustainable consumption beyond the purchase decision. Even though the students in the activity recognized the importance of other decisions related to the use and final disposition of the product, there is an opportunity to acknowledge more choices as part of sustainable consumption. Thus, based on the literature, the results show a somewhat narrow view about the consumption decisions that could be extended to other habits and practices associated with more sustainable lifestyles (Akenji and Chen, 2016).

Third, assign relevance to the social dimension of sustainability, adding it to the environmental aspects in the description of sustainable consumption. However, the findings showed that the students increasing the association of social aspects to the concept only timidly. The activity, including my own experience and research about pro-environmental and social behaviors, shows that there is still little information and approach to social issues under the concept of sustainable consumption. Previous literature asserts that a sustainable lifestyle goes beyond material consumption. So, the social impacts of consumption should be equally considered on behavior decisions (Akenji and Chen, 2016). Therefore, there is a lot of work to extend the view on sustainable consumption including the social dimension of sustainability.

From the perspective of the magnitude of the change in the patterns, strategies, and lifestyles of the actors involved in consumption, the results showed that students maintained a somewhat narrow vision of sustainable consumption in this sense, associating the concept with maintaining the status quo; this is, through small changes that maintain the current patterns of development, consumption, and lifestyle, but striving to produce a lower environmental impact (Hopwood et al., 2005). This might suggest that, from their experience as consumers, the students achieved small changes in their daily routine but no substantial changes in their consumption patterns. This finding may be fit in what previous literature has referred to as a weak vs a strong version of sustainable consumption (Fuchs and Lorek, 2005). Additionally, the elements they identified in organizational initiatives were practices aimed at maintaining the status quo through efficiency and technology improvements, but away from radical change and transformation toward sustainability. This finding agrees with the literature that has pointed out how the discourse, from some actors (e.g. organizations and governments), on sustainable consumption maintains the idea of modifying the production processes as well as the attributes of the products, avoiding a structural change in the system (Fuchs and Lorek, 2005; Akenji, 2014). Although improving eco-efficiency could be a prerequisite for achieving sustainable consumption, it is a weak version of this construct (Fuchs and Lorek, 2005).

The foregoing suggests that the design of experiences or dynamics of approach to reality, together with constant dialogue with their peers and teachers, enables students to

develop greater learning skills, such as the development of critical and systemic thinking, which was verified in the students' construction of increasingly complex mind maps.

Finally, this study highlights the importance of autonomous learning, constructing knowledge through action and the students' own experience (Rieckmann, 2018), which in this case is mediated through the guidance of a teacher. In addition to this, mental maps, which are a powerful tool to demonstrate in a graphical form the progression in the construction of meanings in an open and structured way, and to facilitate the process of evaluation and qualification of systemic thinking skills, become a valuable strategy in Education for Sustainable Consumption (ESC) (Gray et al., 2019). Because the learning outcomes might be different in different settings and contexts, we invite other researchers to adopt this teaching and evaluation method to gain broader insights and to induce

further impact on the learning and adoption of more sustainable consumption and lifestyles.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

Conceptualization, CA and AMV-R; Data curation, MM-P; Formal analysis, CA, AMV-R and MM-P; Investigation, CA; Methodology, CA, AMV-R and MM-P; Writing—original draft, CA and AMV-R; Writing—review and editing, CA and AMV-R.

REFERENCES

- Akenji, L., and Chen, H. (2016). A Framework for Shaping Sustainable Lifestyles: Determinants and Strategies. Available at: http://sd.defra.gov.uk/2011/10/framework-for-sustainable-lifestyles/?utm_source=email&utm_medium=A78J29N,135CGH,1JUBC,1.
- Akenji, L. (2014). Consumer Scapegoatism and Limits to green Consumerism. *J. Clean. Prod.* 63, 13–23. doi:10.1016/j.jclepro.2013.05.022
- Altrichter, H., and Posch, P. (2013). *Innovation in Education through Action Research. En Action Research, Innovation and Change*. New York City, NY: Routledge, 24–42.
- Ananiadou, K., and Claro, M. (2009). 21st Century Skills and Competences for New Millennium Learners in OECD Countries. *OECD Edu. Working Pap.* 41. doi:10.1787/218525261154
- Angelo, T. A., Cross, K., and Reznick, C. (1993). Classroom Assessment. *Metropolitan Universities* 4 (1), 5–15.
- Ausubel, D. P. (1960). The Use of advance Organizers in the Learning and Retention of Meaningful Verbal Material. *J. Educ. Psychol.* 51 (5), 267–272. doi:10.1037/h0046669
- Barth, M., Adomfent, M., Fischer, D., Richter, S., and Rieckmann, M. (2014). Learning to Change Universities from within: A Service-Learning Perspective on Promoting Sustainable Consumption in Higher Education. *J. Clean. Prod.* 62, 72–81. doi:10.1016/j.jclepro.2013.04.006
- Berthou, B., and Marchand, C. (2010). Les cartes cognitives: Quelles utilisations en soins infirmiers. *Recherche en soins infirmiers, N° 101* (2), 29–41.
- Bonilla, C. M. P. (2018). Experiencias de aprendizaje significativo para la apropiación de conocimientos en ciencias económicas, administrativas y contables. Institución Universitaria Politécnica Gran Colombiano. Available at: <https://dialnet.unirioja.es/servlet/libro?codigo=787765>.
- Buzan, T. (1996). *Libro de los Mapas Mentales*. Barcelona, España: Urano, SA.
- Chappells †, H., and Shove ‡, E. (2005). Debating the Future of comfort: Environmental Sustainability, Energy Consumption and the Indoor Environment. *Building Res. Inf.* 33 (1), 32–40. doi:10.1080/0961321042000322762
- Craik, F. I. M. (2020). Remembering: An Activity of Mind and Brain. *Annu. Rev. Psychol.* 71 (1), 1–24. doi:10.1146/annurev-psych-010419-051027
- Evans, D. S., and Leighton, L. S. (1989). The Determinants of Changes in U.S. Self-Employment, 1968–1987. *Small Bus Econ.* 1 (2), 111–119. doi:10.1007/BF00398629
- Faham, E., Rezvanfar, A., Movahed Mohammadi, S. H., and Rajabi Nohooji, M. (2017). Using System Dynamics to Develop Education for Sustainable Development in Higher Education with the Emphasis on the Sustainability Competencies of Students. *Technol. Forecast. Soc. Change* 123, 307–326. doi:10.1016/j.techfore.2016.03.023
- Fatawi, I., Degeng, I. N. S., Setyosari, P., Ulfa, S., and Hirashima, T. (2020). Effect of Online-Based Concept Map on Student Engagement and Learning Outcome. *Int. J. Distance Edu. Tech. (Ijdet)* 18 (3), 42–56. doi:10.4018/IJDET.2020070103
- Frank, P., and Stanszus, L. S. (2019). Transforming Consumer Behavior: Introducing Self-Inquiry-Based and Self-Experience-Based Learning for Building Personal Competencies for Sustainable Consumption. *Sustainability* 11 (9), 2550. doi:10.3390/su11092550
- Fuchs, D. A., and Lorek, S. (2005). Sustainable Consumption Governance: A History of Promises and Failures. *J. Consum. Pol.* 28 (3), 261–288. doi:10.1007/s10603-005-8490-z
- Gairin Sallán, J., and Muñoz, M. (2006). Análisis de la interacción en comunidades virtuales. *Educar* 37, 125–150.
- García-Morales, V. J., Garrido-Moreno, A., and Martín-Rojas, R. (2021). The Transformation of Higher Education after the COVID Disruption: Emerging Challenges in an Online Learning Scenario. *Front. Psychol.* 12, 196. doi:10.3389/fpsyg.2021.616059
- Geiger, S. M., Fischer, D., and Schrader, U. (2018). Measuring what Matters in Sustainable Consumption: An Integrative Framework for the Selection of Relevant Behaviors. *Sust. Dev.* 26 (1), 18–33. doi:10.1002/sd.1688
- Goy, A., Magro, D., Petrone, G., Picardi, C., Rovera, M., and Segnan, M. (2017/2017). “An Integrated Support to Collaborative Semantic Annotation,” in *Advances in Human-Computer Interaction*. doi:10.1155/2017/7219098
- Gray, S., Sterling, E. J., Aminpour, P., Goralnik, L., Singer, A., Wei, C., et al. (2019). Assessing (Social-Ecological) Systems Thinking by Evaluating Cognitive Maps. *Sustainability* 11 (20), 5753. doi:10.3390/su11205753
- Greene, M., Szejnwalk Brown, H., Vergra, P. J., and Cheltenham, E. E. (2013). Innovations in Sustainable Consumption: New Economics, Socio-Technical Transitions and Social Practices. *Irish Geogr.* 46 (3), 263–265. doi:10.1080/00750778.2014.906982
- Hanss, D., and Böhm, G. (2012). Sustainability Seen from the Perspective of Consumers. *Int. J. Consumer Stud.* 36 (6), 678–687. doi:10.1111/j.1470-6431.2011.01045.x
- Hopwood, B., Mellor, M., and O'Brien, G. (2005). Sustainable Development: Mapping Different Approaches. *Wiley Interscience* 13, 38–52. *Sust. Dev.* Sustainable Development—Mapping Different Approaches—2009.pdf (Обект application). doi:10.1002/sd.244
- Khalili, N. R., Melaragno, W., and Haddadian, G. (2011). Practical Sustainability: From Grounded Theory to Emerging Strategies. *Pract. Sustainability*, 207–224. doi:10.1057/9780230116368
- LaPointe *, D. K., and Gunawardena, C. N. (2004). Developing, Testing and Refining of a Model to Understand the Relationship between Peer Interaction and Learning Outcomes in Computer-mediated Conferencing. *Distance Edu.* 25 (1), 83–106. doi:10.1080/0158791042000212477
- Lave, J., and Wenger, E. (2001). “Legitimate Peripheral Participation in Communities of Practice,” in *En Supporting Lifelong Learning* (London, United Kingdom: Routledge), 121–136.
- Legrand, E. (2000). Utilisation pragmatique de cartes mentales comme outil d'évaluation en éducation relative à l'environnement. *ere 2.*, 2000 Article Volume 2. doi:10.4000/ere.6997
- Levi Strauss and Co (2015). *The Life Cycle of A Jean. Understanding the Environmental Impact of a Pair of Levi's 501 Jeans*. San Francisco, CA: Levi Strauss & Co., 16–50.

- Lincoln, Y. S., and Guba, E. G. (1986). But Is it Rigorous? Trustworthiness and Authenticity in Naturalistic Evaluation. *New Dir. Program Eval.* 1986 (30), 73–84. doi:10.1002/ev.1427
- Liu, Y., Qu, Y., Lei, Z., and Jia, H. (2017). Understanding the Evolution of Sustainable Consumption Research. *Sust. Dev.* 25 (5), 414–430. doi:10.1002/sd.1671
- Liu, Y., Zhao, G., Ma, G., and Bo, Y. (2014). The Effect of Mind Mapping on Teaching and Learning: A Meta-Analysis. *Stand. J. Edu. Essay* 2 (1), 17–31.
- Lorek, S., Vergragt, P., Lorek, S., and Vergragt, P. (2015). *Sustainable Consumption as a Systematic Challenge*. Cheltenham, United Kingdom: Chapter 1.pdf.
- Lourdel, N., Gondran, N., Laforest, V., Debray, B., and Brodhag, C. (2007). *Sustainable Development Cognitive Map: A New Method of Evaluating Student Understanding*. *Int. J. Sustainability Higher Edu.* doi:10.1108/14676370710726634
- Loureiro, S. M. C., Bilro, R. G., and Angelino, F. J. d. A. (2020). Virtual Reality and Gamification in Marketing Higher Education: A Review and Research Agenda. *Sjme* 25, 179–216. ahead-of-print(ahead-of-print). doi:10.1108/SJME-01-2020-0013
- Mandrikas, A. (2020). Teaching SDGs Using Concept Maps in Primary Teacher Training. *J. Edu. Sustain. Dev.* 14 (2), 205–234. doi:10.1177/0973408220980873
- Maniates, M. F. (2001). Individualization: Plant a Tree, Buy a Bike, Save the World. *Glob. Environ. Polit.* 1 (3), 31–52. doi:10.1162/152638001316881395
- Mishra, L., Gupta, T., and Shree, A. (2020). Online Teaching-Learning in Higher Education during Lockdown Period of COVID-19 Pandemic. *Int. J. Educ. Res. Open* 1, 100012. doi:10.1016/j.ijedro.2020.100012
- Novak, J. D. (1990). Concept Mapping: A Useful Tool for Science Education. *J. Res. Sci. Teach.* 27 (10), 937–949. doi:10.1002/tea.3660271003
- Novak, J. D., Gowin, D. B., and Otero, J. (1988). *Aprendiendo a Aprender*. Barcelona, Spain: Martínez roca Barcelona.
- Novak, J. D. (2010). *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*. New York City, NY: Routledge.
- Peattie, K., and Collins, A. (2009). Guest Editorial: Perspectives on Sustainable Consumption. *Int. J. Consumer Stud.* 33 (2), 107–112. doi:10.1111/j.1470-6431.2009.00758.x
- Peña, A. O., Gómez, J. P. R., and Sánchez, A. de L. (2003). *Aprender con mapas mentales: Una estrategia para pensar y estudiar*. Madrid, Spain: Narcea. Available at: <https://dialnet.unirioja.es/servlet/libro?codigo=206247>.
- Pepper, M., Jackson, T., and Uzzell, D. (2009). An Examination of the Values that Motivate Socially Conscious and Frugal Consumer Behaviours. *Int. J. Consumer Stud.* 33 (2), 126–136. doi:10.1111/j.1470-6431.2009.00753.x
- Prasetya, D. D., Hirashima, T., and Hayashi, Y. (2020). Study on Extended Scratch-Build Concept Map to Enhance Students' Understanding and Promote Quality of Knowledge Structure. *Ijacsa* 11, 144–153. doi:10.14569/IJACSA.2020.0110420
- Pudelko, B., and Basque, J. (2005). *Logiciels de construction de cartes de connaissances: Des outils pour apprendre*. Montreal, QC: Undefined. Available at: <https://www.semanticscholar.org/paper/Logiciels-de-construction-de-cartes-de-Des-outils-Pudelko-Basque/1a734c8852b38e6d2eca8d60f768118e7efd1847>.
- Reiska, P., Soika, K., and Cañas, A. J. (2018). Using Concept Mapping to Measure Changes in Interdisciplinary Learning during High School. *Knowledge Manage. E-Learning: Int. J.* 10 (1), 1–24.
- Rieckmann, M. (2018). in *Issues and Trends in Education for Sustainable Development*. Editors E. A. Leicht, J. Heiss, and W. J. Byund (United Nations Educational, Scientific and Cultural Organization). doi:10.3726/978-3-653-04538-3
- Roberts, J. A. (1996). Green Consumer in the 1990: Profile and Implications for Advertising. *J. Business Res.* 36-32963 (95), 217–232. doi:10.1016/0148-2963(95)00150-6
- Schmidheiny, S. (1993). *Business and the and Responsibilities Environment: Opportunities*, 108–110. February.
- Segalàs Coral, J. (2009). *Engineering Education for a Sustainable Future*. Barcelona, Spain: Universitat Politècnica de Catalunya.
- Segalàs, J., Ferrer-Balas, D., and Mulder, K. F. (2008). Conceptual Maps: Measuring Learning Processes of Engineering Students Concerning Sustainable Development. *Eur. J. Eng. Edu.* 33 (3), 297–306. doi:10.1080/03043790802088616
- Straughan, R. D., and Roberts, J. A. (1999). Environmental Segmentation Alternatives: A Look at green Consumer Behavior in the New Millennium. *J. Consumer Marketing* 16 (6), 558–575. doi:10.1108/07363769910297506
- Thornton, A. (2009). *Public Attitudes and Behaviours towards the Environment—Tracker Survey: A Report to the Department for Environment, Food and Rural Affairs* Food And (Número September). London, United Kingdom: En A research report completed for the Department for Environment, 1–91.
- Toffel, M. W. (2003). The Growing Strategic Importance of End-Of-Life Product Management. *IEEE Eng. Manag. Rev.* 31 (3), 61. doi:10.1109/emr.2003.24907
- Vare, P., and Scott, W. (2007). Learning for a Change. *J. Edu. Sustain. Dev.* 1 (2), 191–198. doi:10.1177/097340820700100209
- Vergragt, P., Akenji, L., and Dewick, P. (2014). Sustainable Production, Consumption, and Livelihoods: Global and Regional Research Perspectives. *J. Clean. Prod.* 63, 1–12. doi:10.1016/j.jclepro.2013.09.028
- Watson, M. K., Pelkey, J., Noyes, C. R., and Rodgers, M. O. (2016). Assessing Conceptual Knowledge Using Three Concept Map Scoring Methods. *J. Eng. Educ.* 105 (1), 118–146. doi:10.1002/jee.20111
- World Resources Institute (2005). *Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-Being: Synthesis*. Washington, DC: Island Press, 155.

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APPENDIX A

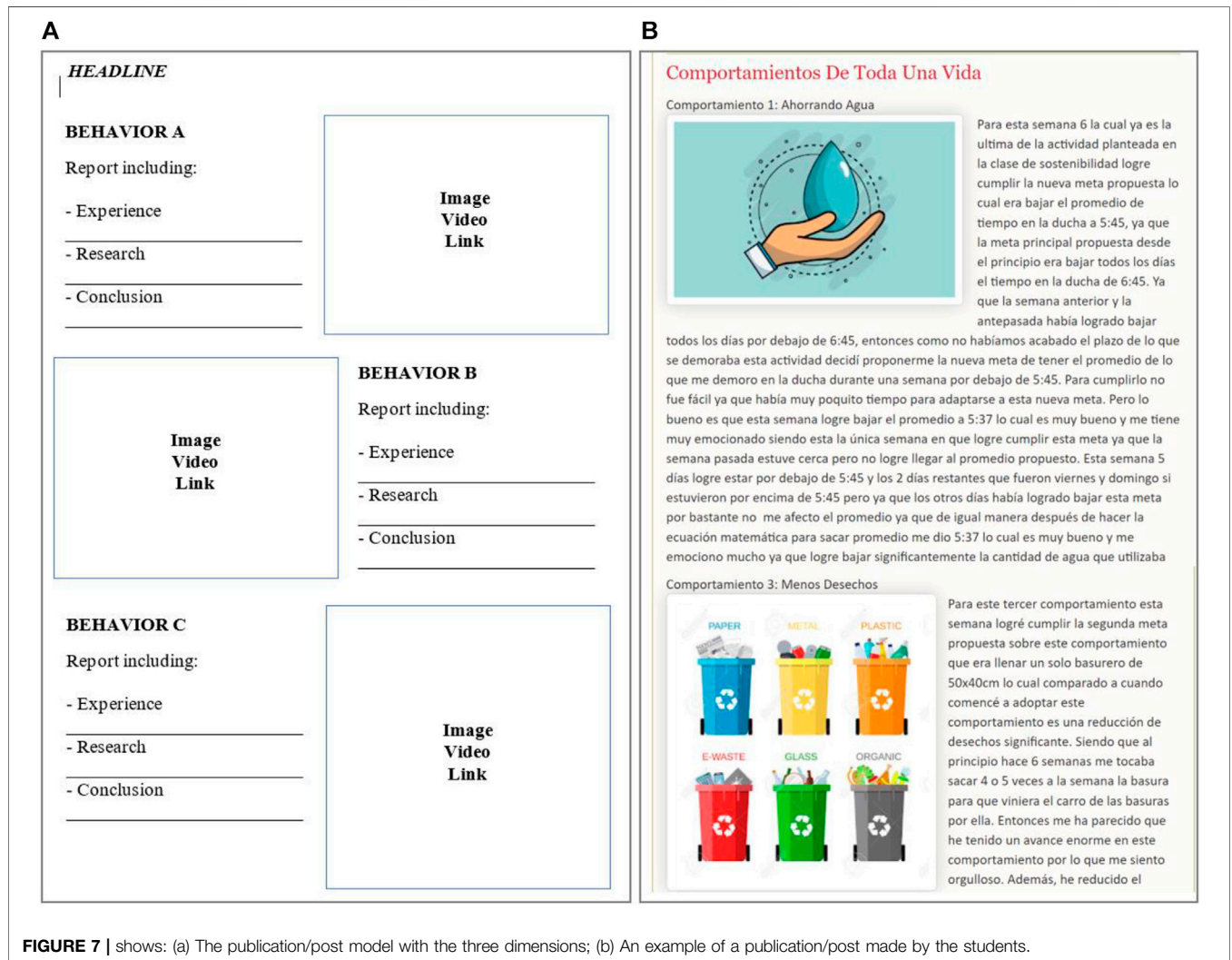


FIGURE 7 | shows: (a) The publication/post model with the three dimensions; (b) An example of a publication/post made by the students.