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Is the "Green Washing" Effect Stronger than Real Scientific Knowledge? Are We Able to Transmit Formal Knowledge in the Face of Marketing Campaigns?

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Abstract: Nowadays, the majority of citizens are subjected to a great deal of (dis)information organized by marketing campaigns or by groups with political interests that indiscriminately abuse concepts such as sustainability, either bio or organic. One of the objectives of formal education in any developed country should be to transmit enough formal (scientific) knowledge about processes and products (related to chemistry, biology, economics, and mathematics) so that citizens can adequately reflect on what is really sustainable and what is not, and also to be able to evaluate the environmental impact of any process. In the first part of this work, we describe the results of a survey that has been carried out in order to assess whether citizens make decisions based on marketing campaigns or based on formal knowledge. It is analyzed if those that have followed STEM studies differ from the rest. In the second part, we propose an activity to be done, in a multidisciplinary approach, by students from both fine arts and engineering, with the objective of consolidating and putting into practice the formal knowledge they have acquired to adequately evaluate the sustainability of a process.

Keywords: sustainability; green chemistry; E factor; circular economy; green washing

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1. Introduction

Every day, more environmental awareness activities are carried out inside and outside the classrooms [1–3]. This includes some abuse by some companies trying to increase sales through "green" and "sustainable" concepts, including "green washing" and other forms of corporate disinformation. The concept green washing is used to refer to the bad practices that some companies carry out when they present a product or any proposal as respectful to the environment, even though it is not. It is a "makeup" for the observer or potential client to give a false idea about something that is not actually as "green" as it appears. Some authors argue that corporate compliance with law is necessary to ensure fair and accurate corporate social reporting, [4] and it is obvious that, in addition, formal education must face disinformation. From the point of view of education, the problem is that students, as with the rest of population, are subjected to an excess of information, often directed by interest groups, that makes them not able to evaluate accurately. As consumers, we are often faced with the decision to pay more for a product that is supposed to be more sustainable, or better for the environment, or to vote for a party that is supposedly concerned about the environment. For example, in Spain, the plans to build waste incineration plants have had to be halted on several occasions due to popular pressure. Instead, landfills are built that have a limited capacity and involve several risks. Indeed, on 6 February 2020 in Zaldibar (Spain), there was an explosion and subsequent collapse, with the death of two workers at the plant, and the emission of toxic gases from the uncontrolled burning of waste. Despite this, public opinion is in favor of landfills and not incinerators in Spain,

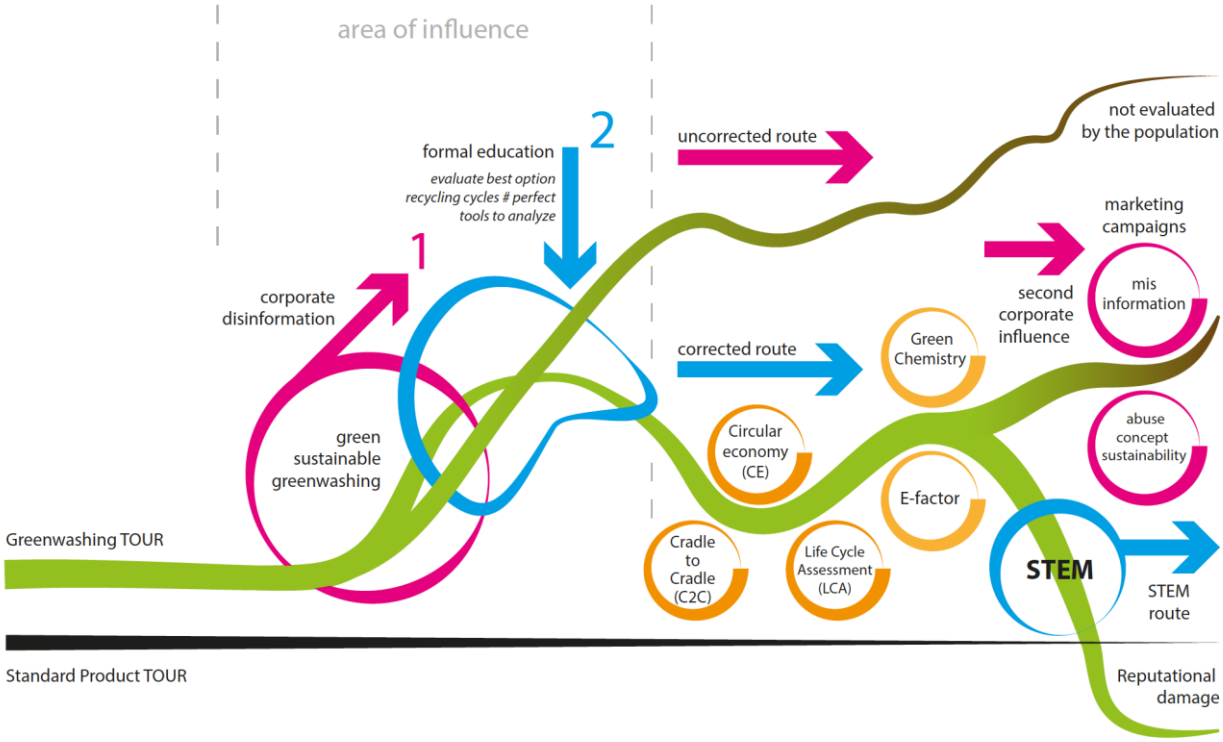
whereas these plants are conceived as a sensible, indispensable part of the waste hierarchy in north European countries [5].

The truth is that perfection rarely exists, everything has pros and cons [6], and an educated citizen should have enough tools to evaluate the pros and cons adequately. Specifically, the manufacture of any product usually requires energy and water, and generates waste. In addition, many processes can only be carried out at a large quantity, which increases the costs of transporting raw materials in many cases [7,8]. When all these technical and economic aspects are considered, it is understood that those recycling cycles that are often represented as far from perfect [9–12], and that it is necessary in each case to evaluate which is the best option [9], since what can appear sustainable or environmentally benign, may not be. The question that arises is whether formal education manages to equip students with the necessary tools to be able to rigorously analyze what is more or less sustainable.

Several tools and parameters have been proposed to evaluate the sustainability of a process or product. Circular economy (CE) and Cradle to Cradle (C2C) provide some principles and strategies for designing products and services for circularity [12–16], which are useful, although several conflicts can be found between theory and practice [12]. This is because a material is usually produced though a chemical process, and to really evaluate the sustainability, it is necessary to consider some technical issues. In this sense, other principles, which consider not only the concept of design but also economical and technical parameters, have been proposed, such as the Green Chemistry principles [17], whose objective is the implementation of chemical processes and products that reduce or eliminate the use and the generation of hazardous substances [18]. Additionally, Prof. Sheldon [19,20] proposed the use of the E-factor as a simple parameter to evaluate the efficiency of a process in terms of starting material utilization, which is related to the concept of atom economy or atom efficiency [21]. These parameters were proposed in the 1990s, due to the fact that the production of waste was so high in several chemical processes, especially in fine chemical synthesis. Since then, many advances have been made in the chemical industry to minimize the consumption of water and energy, and also the amount of waste produced. Additionally, some of these concepts have been introduced in several undergraduate and postgraduate programs [22–25], including in the organization of education institutions [26,27], although they are still far from becoming systemically infused into the undergraduate chemistry and engineering curricula [28]. Other important tool is LCA (Life Cycle Assessment), which provides a quantitative assessment of the environmental impact of products over their entire life cycle, with a view to making improvements [29]. LCA is taught usually in advanced engineering programs. Thus, formal education involves several rigorous tools that must be included in the curricula, to face disinformation and non-scientific ideas (Scheme 1). The question arises about if formal education is able to fight disinformation or not; or, in other words, if an educated person has the tools to correctly evaluate terms such as sustainable or environmentally benign.

We therefore see that tools have been proposed to be able to correctly assess the sustainability of products and processes, although these require some technical knowledge that can be adapted to each level in formal education. For this reason, for some years, these tools have been introduced in formal education, according to each level, in basic chemistry courses and other technical disciplines in undergraduate and high school courses, and some general concepts are taught to children at the primary education level. However, as has been stated in the previous paragraph, there is also the problem of misinformation and abuse of the concept of sustainability by certain political interest groups and marketing campaigns. This paper addresses a study to assess whether some of these concepts have been assumed by the general public, and whether those who have studied or are studying STEM (science, technology, engineering and mathematics) disciplines have assumed them, and take them into account when making decisions as consumers. This will allow us to evaluate if formal education is able to transmit the rigorous knowledge and thinking capacity that educated citizens should have. Since it is necessary that at least part of these

ideas also be assumed by people who do not study STEM disciplines, the present work proposes in the second part a multidisciplinary case study that has been carried out with engineering and fine arts design students, to help both strengthen this knowledge from a practical perspective.



Scheme 1. Tools to evaluate the sustainability of a process or product and their relationship with formal education and disinformation.

2. Methods

A questionnaire (additional information) developed on a Google form that remained accessible for two months was publicized on social media and by mailing list distribution to get as much responses as possible. The same questionnaire was also filled in by the students of engineering and fine arts at the University of Málaga who participated in the proposed activity, both before and after their participation. The questionnaire has four parts; the first part contains basic questions about gender, age and education level acquired, in order to characterize adequately the sample (Table 1). The objective was to have a general idea of the perception of the population regarding what is sustainable and what is not; therefore, a very short test was designed with very simple questions, and it was completed by people of different social strata, ages and educational levels. The questions that were included in the second part of the questionnaire are presented in Table 2. The questions are not easy to respond to, and require one to analyze or to think in many factors, because some options could be sustainable or not, depending the context, but the number of persons that selected the "do not know/do not answer" option was negligible. This fact, even between the students, indicated that the general perception was that the questions were very simple and the answers were selected very quickly and without doubts. To solve this, we also included a third part of questions in the survey, which included three questions: "did you think on the accessibility of the raw materials used", "did you think on the environmental issues associated with the fabrication process proposed?" and finally, "would you change any of your previous answers?" The last part contained three questions about the perception of the abuse of the term "sustainable" by marketing campaigns and groups with political interests.

Table 1. Description of sample.

Control Variable	*N* = 345	%
STEM	93	27% who have studied STEM disciplines
	252	73% who have studied non-STEM disciplines
Age	13	3.8% 0–15 years
	62	18% 16–30 years
	73	21.2% 31–45 years
	174	50.4% 46–60 years
	23	6.7% 61 or + years
Gender	195	56.5% female
	148	42.9% male
Degree	35	10.1% PhD
	169	49% Bachelor / Graduate
	19	5.5% 4th year of studies
	8	2.3% 3rd year of studies
	21	6.1% 2nd year of studies
	6	1.7% 1st year of studies
	52	15.1% Baccalaureate
	35	10.1% Basic/secondary education

Table 2. Case studies proposed to engineering students.

Case Studies
Biodiesel vs. Diesel
Electric cars vs. Combustion cars
Conventional construction materials vs. Construction materials obtained from waste
Fuels obtained from waste, the case of Cardiles oil vs. Conventional fuels
Plastic cups and straws vs. Paper ones
Fuel cells cars vs. Combustion cars
Plastic bags vs. Bags manufactured from potatoes
Plastics water bottles vs. Cardboard bottles

It should be considered that the study has been performed with a small group of students and the general public (*N* = 345), but with enough participants to underline some conclusions and some pedagogic actions that can be proposed. The study has been performed according to the Ethics Code of the University of Malaga (UMA) approved 14 May 2019, and published 11 June 2019 in the Oficial Bulletin of Spanish Kingdom (BOE). The Code of Ethics Guarantees Commitee of UMA is the body in charge of guaranteeing the principles that make up this code. All UMA researchers follow this code. According to this, prior to conducting the study, all individuals participating in it were duly informed of the objectives, methods, and benefits of the study, and of any other relevant aspects. All personal data have been treated in accordance with the data protection law and with all precautions to protect the privacy of the research subjects and the confidentiality of their personal information.

3. Results and Discussion

3.1. Students and General Public Perceptions

Figure 1 shows the survey results as a function of age (A) and gender (B) according to the questions (Table 3). These figures show that the results are not affected by age or gender, since no significative differences are observed. Only in the case of the question regarding biodiesel versus diesel can it be observed that "diesel" is the preferred answer for people between 46 and 60 years old, with biodiesel being the preferred answered for the rest of the ages. As has been mentioned in the methods section, the responses to the third block of the survey indicated that the answers were given without reflection, and the selected answers confirm and shows that no formal tools have been used to think or

to compare both options. For example, the preferred answer regarding biodiesel shows that people do not know that it is obtained from vegetal oils and alcohol, and that only a small amount of biodiesel could be produced in a sustainable way. In addition, some of the options are food sources, such as the one about making plastic bags from potatoes, and almost nobody considered the use of a food source that requires water, fertilizers and pesticides for manufacturing plastic bags.

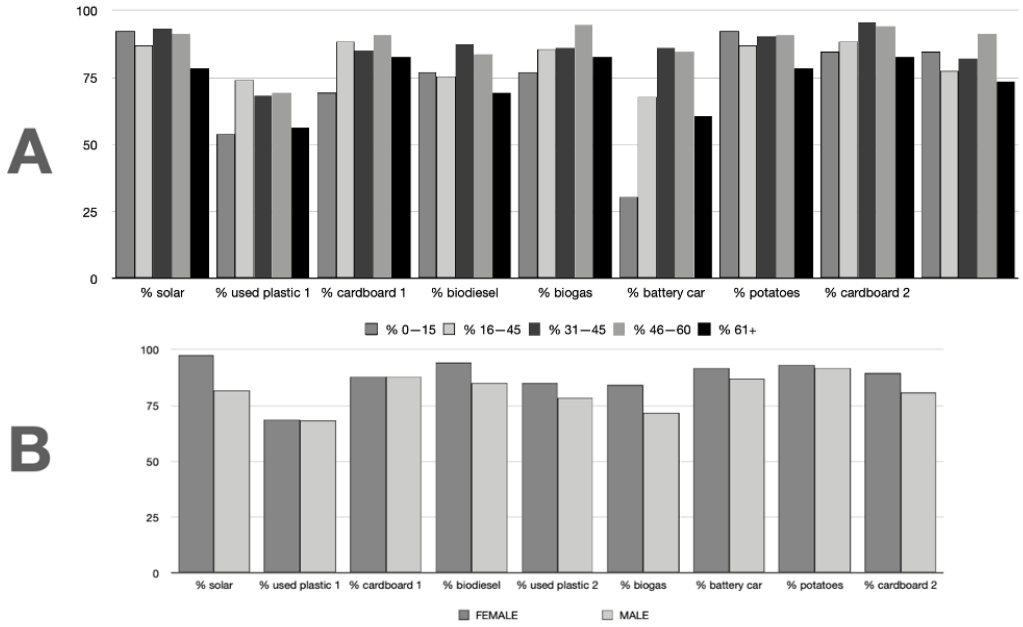


Figure 1. Survey results as a function of age (**A**) and gender (**B**).

Table 3. Survey main questions.

Which of These Options Is More Environmentally Benign?
Solar energy vs. Nuclear energy
Conventional construction materials vs. Construction materials obtained from plastic waste
Straws made from plastic vs. Cardboard
Biodiesel vs. Diesel
Fuels obtained from waste vs. Conventional fuels
Biogas vs. Gas natural
Oil car vs. Battery car
Plastic made from potatoes vs. Classic plastic
Plastics water bottles vs. Cardboard bottles

It could be thought that people that have studied or who are studying any STEM discipline should have enough formal tools to consider the different aspects of both options, and, at least, to have some doubts about which option is more sustainable. Survey results as function of STEM or not STEM studies are shown in Figure 2. Such doubts would mean that the answers would be closer to 50% in some cases, and not higher than 70–75% for the option whose publicity makes us think that it is more environmentally benign. These results indicate that there is not a great difference in thinking between people who have studied disciplines related to science and engineering and the rest of the population. Since the sustainability of chemical or energy production processes are concepts not always included in all STEM disciplines, this could explain such results, indicating that it is necessary to include formal tools such as LCA, green chemistry or C2C in all the disciplines and education levels.

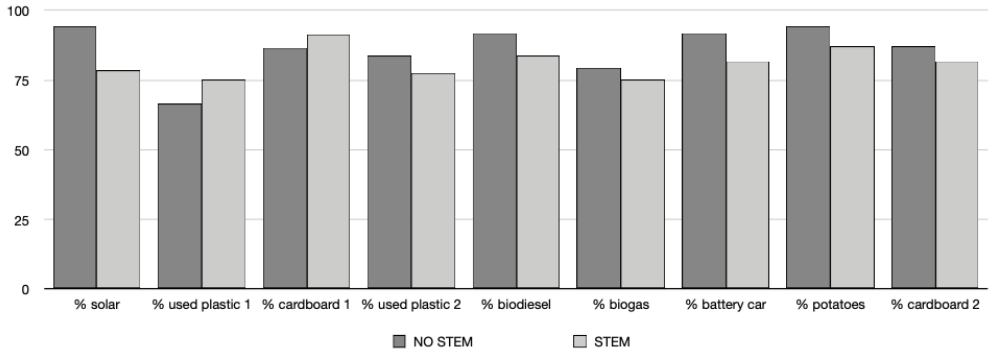


Figure 2. Survey results as a function of population that has completed STEM studies.

3.2. Multidisciplinary Intervention Case Study Proposal

The results of the study show that it is necessary from formal education make a greater effort to introduce rigorous thinking and knowledge to students of both STEM and non-STEM disciplines. To achieve this objective, a multidisciplinary and practical activity was performed by second year students of Industrial Organization Engineering and those on the Design of the Fine Arts course at Malaga University. Engineering students study the subjects of chemical and environmental technology, and the principles of green chemistry, and were asked to prepare work on the evaluation of the complete life cycle of a product or process. Table 2 shows the themes that were proposed to each group of students. For each case, they had to evaluate, and estimate numerically, the energy and materials costs of all the steps involved in the production of the product or service of the two options given to them, including its disposal when its useful life time ends. They also had to qualitatively evaluate the environmental issues associated to each case. Afterwards, they prepared an oral presentation to explain the most important results and the conclusions obtained. This exhibition was attended by Fine Arts students, who used the information acquired for the selection of materials to carry out their final project. Fine Art students had to develop a process that included the definition of a product. In the first stage, they had to analyze the potential user, their tastes and needs, in terms both of corporate strategy and production technology, including the operating distribution and the cultural and social context, trying to integrate it into models of future consumption/experiences scenarios. The student was invited to consider different points of view, in order to foresee the possible development of a selected product or service, by which the student seeks an understanding of the market dynamics, the values of the typological and formal aspects of the technology, a means of communication development, and a model of action and behaviors, as well as the dissemination, to determine the success of the perceived image.

As expected, the technical quality of the engineering students' work showed that they had assumed the principles of green chemistry in their estimations. During the oral presentation of the works, intense debates took place between all the students, including those who had done it and the rest, and also with the students of fine arts that did not have the technical expertise, but brought other points of view to the discussions. The issue of the Cardiles oil company was especially striking and generated an intense debate [30]. It was a case that occurred in Spain some years ago in which a business group claimed to have a patent for a catalyst capable of transforming any substance into biodiesel. This was obviously fake, very easy to note for any person with a basic knowledge about catalysis. However, many people, and especially some very famous ones, such as singers and soccer players, invested money in this company, which turned out to be a complete scam and ended up in court. This company received, in addition, a lot of public subventions for starting up some biodiesel production plants that they did not ever launch. Scams of this type are more and more frequent based on the misinformation that people have about the product, which makes it even more necessary to assess these concepts from a rigorous point of view in formal studies. The discussion regarding the use of biodiesel and bioalcohol was

also very interesting, showing that it is not viable as a substitute for fossil fuels and that it can only be produced in small quantities, which is interesting in certain cases, but is not going to be a global solution. In this sense, the students also investigated what was called the "tortilla crisis", when the public aid that was given by the EU for the starting up of bio-oils production plants, and the demand for corn by the USA for producing bioethanol, increased the price of food in several countries. Furthermore, once the subsidies were withdrawn, the plants closed, as they were not viable. After the crisis, the production of bio-oils was oriented towards the use of starting materials that are not used for food. In addition, the discussion turned towards the conflict over deforestation enacted by the oil plantations necessary to produce biodiesel. Design students, for their part, were surprised by the sustainability of biomass-based products, which are becoming very popular for many designers and artists (such as potato bags, banana items or mushroom-based materials). They had never studied or thought that these materials could compete with food use, and in addition, that they also require irrigation water, fertilizers and fumigants, in addition to having high transport and land use costs [8], which makes them not as sustainable as they appear. Participating in this work really got them thinking about the materials that they were going to use in their final project, and especially about what is really an "eco-friendly product".

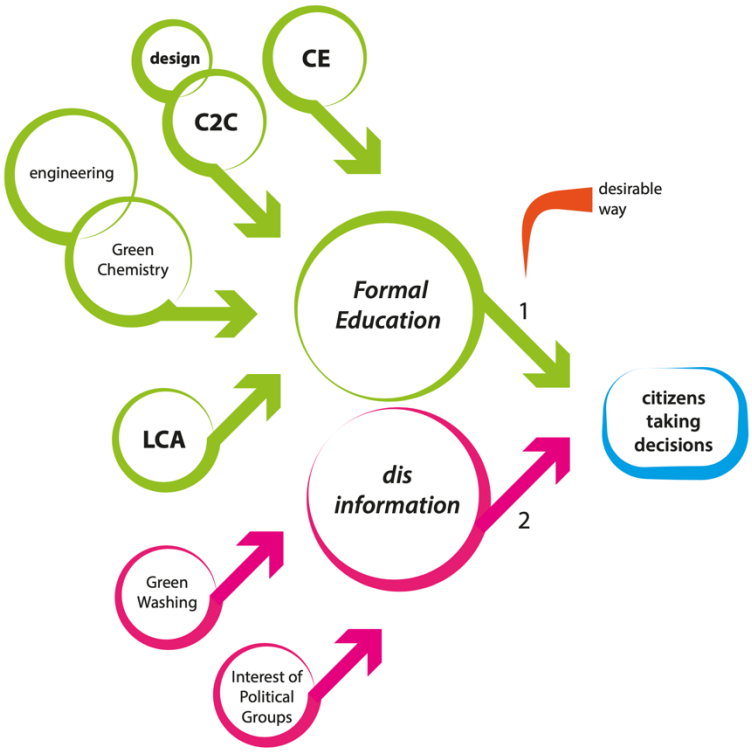
To quantitatively evaluate how much the activity changed students' minds, all of them did the survey again. The results are shown in Table 4, and show how the answers changed in all cases. Before doing the task, the answers given by the students were similar to those given by the general public without STEM studies, as was discussed in the previous section. In general, it is observed that before participating in the activity, the students responded by letting themselves be carried away by concepts such as "bio", without analyzing the different aspects involved. They simply thought that everything bio is good, and that everything made with oil, like plastic, is bad (probably due to the marketing campaigns). Participating in the activity, and thinking about aspects such as the water and energy consumed by the processes, the viability of the raw materials, or the amount of waste that is generated, made them change their minds. This change of opinion was observed to be more drastic in terms of the use of fuels made with plastics and bags made with potatoes, two of the topics on which a more intense debate was generated.

Table 4. Survey results for students before and after participating in the proposed activity.

	Engineering Students		**Design Students**	
	Before	**After**	**Before**	**After**
Solar or nuclear?	solar 63%	solar 55%	solar 76%	solar 67%
Conventional building materials or from used plastics?	used plastics 60%	used plastics 32%	used plastics 82%	used plastics 65%
Plastic or carboard straws?	cardboard 89%	cardboard 71%	cardboard 100%	cardboard 88%
Biodiesel or diesel?	biodiesel 62%	biodiesel 28%	biodiesel 95%	biodiesel 55%
Petroleum conventional oil or oil made from used plastics?	used plastics 61%	used plastics 12%	used plastics 98%	used plastics 48%
Biogas or natural gas?	biogas 76%	biogas 21%	biogas 97%	biogas 76%
Battery electric car or conventional car?	battery car 66%	battery car 43%	battery car 96%	battery car 78%
Plastic from potatoes or conventional plastics?	potatoes 69%	potatoes 11%	potatoes 100%	potatoes 32%
Plastic water bottles or cardboard ones?	cardboard 76%	cardboard 51%	cardboard 96%	cardboard 61%

4. Conclusions

The survey carried out shows how people are more influenced by marketing campaigns than by the formal education they have received. Although they claim to have reflected on raw materials and products, given that concepts related to the environment and sustainability are used indiscriminately by advertising campaigns, the truth is that they are carried away by it when making a decision. For example, a large majority think that it is better to use biogas over natural gas, without thinking that biogas is produced in small quantities from waste and that it cannot be used as a substitute for natural gas. These data show that it is necessary to address these issues in the different educational stages, so that citizens have rigorous tools (Scheme 2) to make decisions appropriately (desirable way 1 in Scheme 2). Unfortunately, the lack of minimal training in these fields is causing it to be abused by marketing campaigns or by the political interests of certain groups, who even make scams or make decisions that have led to subsidizing unviable processes. Our intervention proposal with students from a multidisciplinary point of view has proven to be a good starting point for students to consolidate and put into practice the tools we have to adequately evaluate the sustainability of a process (C2C, CE, LCA, E factor, Green Chemistry, etc.).



Scheme 2. Ways/tools that citizens have to take decisions or to make evaluations.

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References

1. Yanniris, C. Education for Sustainability, Peace, and Global Citizenship: An Integrative Approach. *Educ. Sci.* **2021**, *11*, 430. [CrossRef]
2. Izagirre-Olaizola, J. Is green marketing an oxymoron? *Trames J. Humanit. Soc. Sci.* **2021**, *25*, 321. [CrossRef]
3. Testa, F.; Iraldo, F.; Vaccari, A.; Ferrari, E. Why Eco-labels can be Effective Marketing Tools: Evidence from a Study on Italian Consumers. *Bus. Strategy Environ.* **2015**, *24*, 252–265. [CrossRef]
4. Laufer, W.S. Social Accountability and Corporate Greenwashing. *J. Bus. Ethics* **2003**, *43*, 253–261. [CrossRef]
5. Kleis, H.; Volund, W.; Soren Dalager, R. *100 Years of Waste Incineration in Denmark: From Refuse Destruction Plants to High-Technology Enery Works*; Babcock & Wilcox Volund A/S and Ramboll: Rotherham, UK, 2004.
6. Kopina, H. Green-washing or best case practices? Using circular economy and Cradle to Cradle case studies in business education. *J. Clean. Prod.* **2019**, *219*, 613–621. [CrossRef]
7. Guerrero-Pérez, M.O.; Calzado, M.; Valero-Romero, M.J.; Rodríguez-Mirasol, J.; Cordero, T. Killing two birds with one Stone: Catalysts prepared by biomass waste for its use for transformation of biomass waste. *Cellul. Chem. Technol.* **2016**, *50*, 831–835.
8. Calzado, M.; Valero-Romero, M.J.; Garriga, P.; Chica, A.; Guerrero-Pérez, M.O.; Rodríguez-Mirasol, J.; Cordero, T. Lignocellulosic-derived basic solids and their catalytic applications in the transformation of biomass waste. *Catal. Today* **2015**, *257*, 229–236. [CrossRef]
9. Guerrero-Pérez, M.O.; Bañares, M.A. Metrics of acrylonitrile: From biomass vs. petrochemical route. *Catal. Today* **2015**, *239*, 25–30. [CrossRef]
10. Toxopeus, M.E.; De Koeijer, B.; Meij, A. Cradle to Cradle: Effective Vision vs. Efficient Practice? *Procedia CIRP* **2015**, *29*, 384–389. [CrossRef]
11. Guerrero-Pérez, M.O.; Valero-Romero, M.J.; Hernández, S.; Nieto, J.M.L.; Rodríguez-Mirasol, J.; Cordero, T. Lignocellulosic-derived mesoporous materials: An answered to manufacturing non-expensive catalysts useful for the biorefinery processes. *Catal. Today* **2012**, *195*, 155–161. [CrossRef]
12. Guerrero-Pérez, M.O.; Rosas, J.M.; López-Medina, R.; Bañares, M.A.; Rodríguez-Mirasol, J.; Cordero, T. Lignocellulosic-derived catalysts for the selective oxidation of propane. *Catal. Commun.* **2011**, *12*, 989–992. [CrossRef]
13. Gerber, E.; McKenna, A.; Hirch, P.; Yarnoff, C. Learning to waste and wasting to learn? How to use cradle to cradle principles to improve the teaching of desing. *Int. J. Eng. Educ.* **2010**, *26*, 314–323.
14. De Pauw, I.C.; Karana, E.; Kandachar, P.; Poppelaars, F. Comparing Biomimicry and Cradle to Cradle with Ecodesing: A case study of student design projects. *J. Clean. Prod.* **2014**, *78*, 174–183. [CrossRef]
15. Ashby, M.; Vakhitova, T. Analyzing and Measuring Circularity—Teaching and Industrial Tools by Granta Design. *MRS Adv.* **2018**, *3*, 1379–1386. [CrossRef]
16. Bovea, M.D.; Ibáñez-Forés, V.; Pérez-Belis, V.; Juan, P.; Braulio-Gonzalo, M.; Díaz-Ávalos, C. Incorporation of Circular Aspects into Product Design and Labelling: Consumer Preferences. *Sustainability* **2018**, *10*, 2311. [CrossRef]
17. Anastas, P.; Eghbali, N. Green Chemistry: Principles and Practice. *Chem. Soc. Rev.* **2010**, *39*, 301–312. [CrossRef]
18. Anastas, P.; Warner, J.C. *Green Chemistry: Theory and Practice*; Oxford University Press: New York, NY, USA, 1998.
19. Sheldon, R.A. Organic synthesis–past, present and future. *Chem. Ind.* **1992**, *23*, 903–906.
20. Sheldon, R.A. The E Factor: Fifteen years on. *Green Chem.* **2007**, *9*, 1273–1283. [CrossRef]
21. Trost, B.M. The Atom Economy–A search for synthetic efficiency. *Science* **1991**, *254*, 1471–1477. [CrossRef]
22. Ciriminna, R.; Albo, Y.; Fidalgo, A.; Ilharco, L.; Pagliaro, M. Silanes for Building Protection: A Case Study in Systems Thinking Approach to Materials Science Education. *Educ. Sci.* **2020**, *10*, 171. [CrossRef]
23. Armstrong, L.B.; Rivas, M.; Zhou, Z.; Irie, L.M.; Kerstiens, G.A.; Robak, M.T.; Douskey, M.C.; Baranger, A.M. Developing a Green Chemistry Focused General Chemistry Laboratory Curriculum: What Do Students Understand and Value about Green Chemistry? *J. Chem. Educ.* **2019**, *96*, 2410–2419. [CrossRef]
24. Wu, N.; Kubo, T.; Sekoni, K.N.; Hall, A.O.; Phadke, S.; Zurcher, D.M.; Wallace, R.L.; Kothari, D.B.; McNeil, A.J. Student-Designed Green Chemistry Experiment for a Large-Enrollment, Introductory Organic Laboratory Course. *J. Chem. Educ.* **2019**, *96*, 2420–2425. [CrossRef]
25. Hjeresen, D.L.; Boese, J.M.; Schutt, D.L. Green Chemistry and Education. *J. Chem. Educ.* **2000**, *77*, 1543. [CrossRef]
26. Guerrero-Pérez, M.O.; Román, G.; Travesedo, C. *Improvements for a Sustainable Distance Education with the New UNED On-Site System for Virtualization of Exams: Malaga Region (Andalucía, Spain) as Case Study*; Springer: Singapore, 2015; pp. 309–317.
27. Bell, S.; Douce, C.; Caeiro, S.; Teixeira, A.; Martín-Aranda, R.; Otto, D. Sustainability and distance learning: A diverse European experience? *Open Learn.* **2017**, *32*, 95–102. [CrossRef]
28. Mackellar, J.J.; Constable, D.J.C.; Kirchhoff, M.M.; Hutchison, J.E.; Beckman, E. Toward a Green and Sustainable Chemistry Education Road Map. *J. Chem. Educ.* **2020**, *97*, 2104–2113. [CrossRef]
29. Burgess, A.; Brennan, D. Application of life cycle assessment to chemical processes. *Chem. Eng. Sci.* **2001**, *56*, 2589–2604. [CrossRef]
30. Several Newspapers in Spain Published News Regarding this Fraud that Was Judge at the Court (See for Example El Mundo 25 October 2015). Available online: https://www.elmundo.es/loc/2015/10/24/562a845eca4741870e8b4667.html (accessed on 10 December 2021).