Informative Initiatives as a Useful Tool to Raise Awareness of Food Waste. An Application to Higher Education

Elena Fraj-Andrés (corresponding autor):

Faculty of Economics and Business Administration, Department of Marketing.

University of Zaragoza. Gran Vía, 2, 50005, Zaragoza (Spain).

Email: efraj@unizar.es

Carolina Herrando

Faculty of Economics and Business Administration, Department of Marketing.

University of Zaragoza. Gran Vía, 2, 50005, Zaragoza (Spain).

Email: cherrando@unizar.es

Laura Lucia-Palacios

Faculty of Economics and Business Administration, Department of Marketing.

University of Zaragoza. Gran Vía, 2, 50005, Zaragoza (Spain).

Email: llucia@unizar.es

Raúl Pérez-López

Faculty of Economics and Business Administration, Department of Marketing.

University of Zaragoza. Gran Vía, 2, 50005, Zaragoza (Spain).

Email: raperez@unizar.es

Informative Initiatives as a Useful Tool to Raise Awareness of Food Waste. An Application to Higher Education

Received 30March 2022 and revised 08 July 2022

Abstract

Purpose: Because food waste is a serious problem today, society is currently aiming for more responsible consumption to minimize it, as defined in the 12th goal of the United Nations Sustainable Development Goals. This study examines whether an informative initiative can help to raise university students' awareness of food waste consequences.

Design/methodology/approach: The initiative consisted of explaining the problem of food waste to students of two marketing subject modules within Economics and Business Administration degrees, and asking them to participate in an activity in which they analyzed their own behavior. To assess its impact, two questionnaires about the students' food waste behaviors were administered, before and after the initiative, adopting an experimental design.

Findings: The results show that the information and awareness activities were successful, since, after the initiative, the students were more aware about the food waste problem and its consequences and were more critical of their behavior regarding the management of leftovers at home.

Research limitations/implications: In spite of some circumstances under which the study was conducted (the COVID-19 pandemic and the lockdown), the practical and social implications are relevant.

Practical implications: This study offers some interesting practical implications for educational institutions that want to inform and train students in more responsible consumption behavior. It shows that an initiative in which students are involved, like collecting data about food waste, in their homes with a diary, and informative sessions can be useful to increase students' awareness of food waste to behave in a more sustainable way.

Social Implications: These findings may be of interest to academics for designing initiatives that try to train and educate young people in making more responsible personal and professional decisions.

Originality/value: The study analyzes the impact of an awareness-raising initiative about food waste in higher education, which is a relatively neglected topic in the literature.
Keywords: Food waste initiative, Sustainable Development Goals, Social marketing, Awareness activities, Higher education.

1. Introduction

Universities should help society to face the challenges of more responsible use of available resources, more effective waste management, and greater respect for the natural environment. This contribution forms part of one of the United Nations Sustainable Development Goals (SDGs, 12th) (United Nations, 2020). Therefore, the promotion of economic, social and environmental sustainability, including the reduction of food waste, should be one of the main functions of higher education (Sibbel, 2009).

Food waste is one of the environmental challenges to work on from university (Filho et al. 2021). Almost a third of the world's food production is wasted or lost along the supply chain, and most food waste occurs at the consumption stage. As a more fundamental solution to the problem of food waste, some studies have proposed initiatives to inform consumers and raise their awareness of more responsible management and handling of food (Young *et al*., 2017; Principato *et al*., 2015).

In this context, initiatives to curb food waste are abundant and varied, internationally, nationally and locally, and have been aimed at all segments of the population, including young people and students (Larrán et al., 2016). Some of these initiatives seek to encourage consumers to reuse and share leftovers (Morone et al., 2018) and consume only what is necessary (Kim et al., 2020; Young et al., 2018). Nevertheless, studies of the effectiveness of different preventive communication initiatives are scarce. This type of

information would be of great help in verifying the impact of these initiatives on consumer behavior.

To reduce this gap, this paper analyzes the degree of success of an awareness-raising initiative about food waste carried out with undergraduate students. It is important to analyze the influence of this type of initiative on behavior, with young people in particular, because although they tend to show high levels of environmental concern, they tend to waste more food than older generations (Ilakovac *et al*., 2020; Principato *et al*., 2015). The university context is therefore ideal for the development of our activity and the achievement of our objective, which is to answer the following research question:

RQ: Are university food waste initiatives a useful tool to raise the students' awareness and change their behavior?

This paper contributes to deeper knowledge about the usefulness of informative nudges for raising awareness about food waste, a relatively neglected topic in the academic literature (Pinto *et al.,* 2018; Schanes *et al*., 2018). It provides a good example of positive action to address the important problem of food waste and the procedure of our initiative can also contribute as a basis for the design of future academic interventions, combining information activities about food waste and its consequences with key tips on how to avoid it.

The study is structured in six sections. Section 2 justifies the importance of the chosen topic in light of the scarcity of similar teaching initiatives in the literature. Section 3 sets out the methodology used. Section 4 presents the results. And, sections 5 and 6 draw the discussion, main implications and conclusions from the findings.

2. Initiatives in Higher Education to Raise Awareness of Food Waste

Food waste has been defined as "*food loss that occurs in the retail and final consumption stages and its generation is related to the retailers and consumers' behavior*" (Parfitt *et al.,* 2010, p. 3065).

Within these stages where food waste occurs, research indicates that young people contribute more to food waste than any other age group (Mallinson *et al*., 2016; Principato, *et al.,* 2015). A study confirmed that young people (under 35 years) are among the consumer groups that waste the most food (MAPAMA, 2018). Given that young people will shape the future scenario on food waste, it is necessary to increase their awareness of more responsible behavior in that area.

The literature on food waste has become more prominent in the last two decades. Most studies have focused on analyzing consumers' awareness of food waste and the factors that influence their behavior (Schanes *et al*., 2018; Stancu *et al*., 2016; Visschers *et al*., 2016; Principato *et al*., 2015). It has been observed that consumers are unaware of most of the consequences of food waste (Principato et al., 2015); they underestimate the cost of wasting a lettuce leaf or a piece of meat because they place little value on food (Mallinson *et al*., 2016). These findings have led to a particular emphasis on the need to raise young consumer awareness about the problem of food waste.

Relatively few initiatives have tried to promote more responsible behaviors in relation to food waste among students at different stages of education, especially in universities (Filho et al., 2021; Feijoo and Moreira, 2020; Ahmed *et al*., 2018; Maher and Burkhart, 2017). Within these institutions, there is concern about the prevention and reduction of food waste in their canteens. But greater involvement between students, staff and managers is needed to be able to curb food waste more effectively (Filho et al., 2021).

In this context, Aschemann-Witzel et al. (2015) noted that it was difficult to find information on food waste initiatives that had been successful and that could serve as an example for the design of future initiatives. In this line, Kim et al. (2020) pointed out that the influence of food waste-related initiatives in consumer behavior should be measured.

Thus, a food waste-related teaching initiative is successful when it achieves its aim, in this case, generating knowledge and awareness about the value of food and the consequences of its waste, prompting students to feel the need to change their behavior and to try to avoid food waste. In this sense, the field of social marketing could help achieve this goal, since it seeks to cause a change in students' behavior (Zamri *et al*., 2020), raising students' awareness of the food waste consequences and encouraging them to reduce the amount of food wasted.

Hübscher et al. (2021) reflect on the role of universities as social marketing partners, promoting changes in students' behavior so that they become agents that, in turn, cause sustainable social change. Balonas and Marques (2018), following the social marketing perspective, also present universities as the best place to stimulate reflection and action regarding food waste and sustainability.

Thus, institutions that seek to reduce food waste should design awareness initiatives within an effective social marketing strategy for changing behaviors. Most institutional food waste initiatives are information-based interventions. However, Soma et al. (2021; 2020), in their recent analysis of the range of formats used in such interventions, found that the best methods of increasing awareness involve combining food waste information campaigns with activities that include participants and engage them in a particular behavioral pattern.

In the context of higher education and food waste practices, previous research has considered a number of teaching experiences aimed at increasing sustainable behaviors and awareness among students, including lectures on theory, information sessions, guest lectures, service learning, practical lessons, case study analysis and debates (Chiba *et al*., 2021; Menon and Suresh, 2020). However, it is important to note that the level of these experiences' success may vary depending on the context of study, that is, on the specific awareness goal (Chiba *et al*., 2021).

In the context of food waste, both information sessions and activities have been deployed to increase students' awareness (Balonas and Marques, 2018; Ahmed *et al*., 2018; Feijoo and Moreira, 2020; Maher and Burkhart, 2017). When Ahmed *et al*. (2018) proposed the inclusion of food waste reduction practices in the canteen of a US university, they involved students in the monitoring of these practices and their results. The intervention aimed to reduce food waste in the student canteen by tracking the problem, promoting student awareness, and applying specific measures to resolve the problem. The intervention was found to be effective in terms of the development of the students' critical thinking. Pinto *et al*. (2018) showed that informing university students about waste in the canteen could be enough to change their waste habits, albeit the results were modest. A Spanish university conducted a project in which Chemical Engineering undergraduates collected data about food waste behaviors in their households (Feijoo and Moreira, 2020). Following the activity, the students reported greater awareness of food waste issues, and approximately 60% of them perceived a change in their own consumption habits.

The present study proposes a teaching initiative that includes several activities and teaching tools: information sessions, challenges, and discussion sessions. Besides, two questionnaires will measure whether these activities are useful to raise awareness and to

push a more sustainable behavior. In the next section, the teaching experience and its measurement will be described in detail.

3. Methodology

Given the main objective of sensitizing university students to the importance of food and the need to reduce food waste, we designed an information activity, including some voluntary active participation from the students, to be embedded into two marketing subject modules. Next, the activity, the questionnaire and the participants are described.

3.1 Design of the Initiative

The initiative analyzed was part of a broader strategy to encourage responsible consumption among 1st year students of a Business Administration degree and an Economics degree. It included four activities and was implemented in two courses: Introduction to Marketing (1st semester at Business Administration) and Fundamentals of Marketing (2nd semester at Economics). The total number of students enrolled in these courses was 468, distributed into three groups of such subjects. Table 1 describes the main aspects of this context and offers an outline of the activities, included in the teaching initiative, explained below.

This initiative, in relation to responsible food consumption, was held in the practical classes of the aforementioned subjects. In both subjects, the activities were carried out with two groups of students, with a third group serving as a control. The activities were conducted in practical sessions for four weeks (one session per week), and about 20 minutes were used in each session.

In the first session, the problem of food waste and its consequences were explained and students were set the challenge of assessing throughout the following week their behavior at home, how much food they wasted and if they believed that the waste was avoidable.

An Excel spreadsheet was provided so that students could record their figures for each day. In the second session, students discussed the data collected during the previous week's challenge, received information about some other consequences of food waste, and were set the same challenge for the following week. In the third session, they were asked again about their behavior during the week and given information on some key methods for reducing food waste at home. Finally, in the fourth session, they were informed about two mobile applications (TooGoodToGo and NiceToEatYou, now Enchanted to Eat You) that can be used to help curb food waste (Table 1).

Table 1. Outline of the Teaching Initiative

PLANNING OF THE ACTIVITIES					
Course of Introduction to Marketing: 1st semester (16 Sept. 2019 - 14 Jan. 2020), 1st year of the Business Administration Degree, (2 treatment groups and 1 control group) **Course of Fundamentals of Marketing:** 2nd semester (10 Feb. 2020 – 26 May 2020), 1st year of the Economics Degree, (2 treatment groups and 1 control group)					
WEEK	**CALENDAR /Subject**		**ACTIVITY**	**CHALLENGE**	**LEARNING GOALS**
	Intro, Mk.	**Fund. Mk.**			
1	23-27 Sept. 2019	17-21 Feb. 2020	Pre-Questionnaire / Information about FW problem and its trace (20') / and challenge proposal and explanation	Students write down in an excel sheet, all the food wasted for one week (until the next practice class)	Distinguish between food loss and waste / Knowing the main causes of the problem
2	30 Sept.- 4 Oct. 2019	24-28 Feb. 2020	Assessment of the results obtained in the students' records on their own experiences and sharing with the rest of their classmates and proposal of extending the challenge	Students write down in an excel sheet, all the food wasted for one week (until the next practice class)	Raise awareness about the amount of food, still in good condition, that is thrown away
3	7-11 Oct. 2019	2-6 March 2020	Assessment of the results obtained the previous week and proposal of advice, tricks, customs that allow curbing food waste		Students get conscious of their practices at home and how they may improve them
4	14-18 Oct. 2019	9-13 March 2020	We asked the class about their perceptions of the activity and informed them about two food waste Apps to fight this kind of waste.		Discover all the possibilities of taking advantage of a food before throwing it away.
5	21-25 Oct. 2019	16-20 March 2020	Post-Questionnaire		

(a) Due to the Covid-19 lockdown, questionnaires in the Fundamental of Marketing course were delivered online

In order to measure the impact of this initiative on the students' perceptions about the food waste problem and to see whether their behavior had changed, an experimental design was adopted, dividing the students into two groups: the treatment group (with students that participated in the activities) and the control group (where students did not take part of the activities). Furthermore, two questionnaires were administered. The content of the questionnaires was almost the same, except that the second one included an additional question about satisfaction with the initiative. Students provided a nickname in the two questionnaires so that both waves could be connected. The first questionnaire (pre-activity) was administered to students, before the start of the first session, to find out their assessments of their food consumption habits inside and outside the home. For students on the Introduction to Marketing course, the second questionnaire (post-activity) was self-administered in the following week, after the end of the last activity. For those on the Fundamentals of Marketing course, due to the COVID-19 lockdown, the questionnaire had to be administered online during the following two weeks, after the end of the last activity.

3.2 Design of the Questionnaire

The questionnaire consisted of 12 items. It began by inquiring about the importance that the students gave to the fight against food waste in relation to other responsible behaviors. The first item listed 10 different behaviors related to responsible consumption which the participants had to rank from 1 to 10 according to their perceived importance. Subsequent items focused on different aspects of the students' habits and practices regarding food waste at home, measured on 7-point Likert scales developed in previous studies: household food waste management skills (Stancu *et al.,* 2016), management of leftovers (Stancu *et al*., 2016), awareness of the consequences of food waste (Zhang *et al*. 2019; Wang *et al*. 2011) and attitude toward food waste (Wang *et al*., 2018). Items about food

waste in restaurants were also drawn from previous studies and focused on attitudes toward food waste and intention to reduce food waste in restaurants (Lorenz *et al*., 2017). The remaining items focused on the frequency with which food was thrown away at home, the amount and types of food thrown away, and other food waste behaviors (Diaz-Ruiz *et al*., 2018). (See the Appendix for details.)

In addition to these items, the second questionnaire measured satisfaction with the activity by means of three items drawn from previous research (Bhattacherjee *et al*., 2012). Intention to recommend the activity to other students or for deployment on other courses was measured using three items on loyalty from a scale proposed by Zeithaml *et al*. (1996) that we adapted to the educational context.

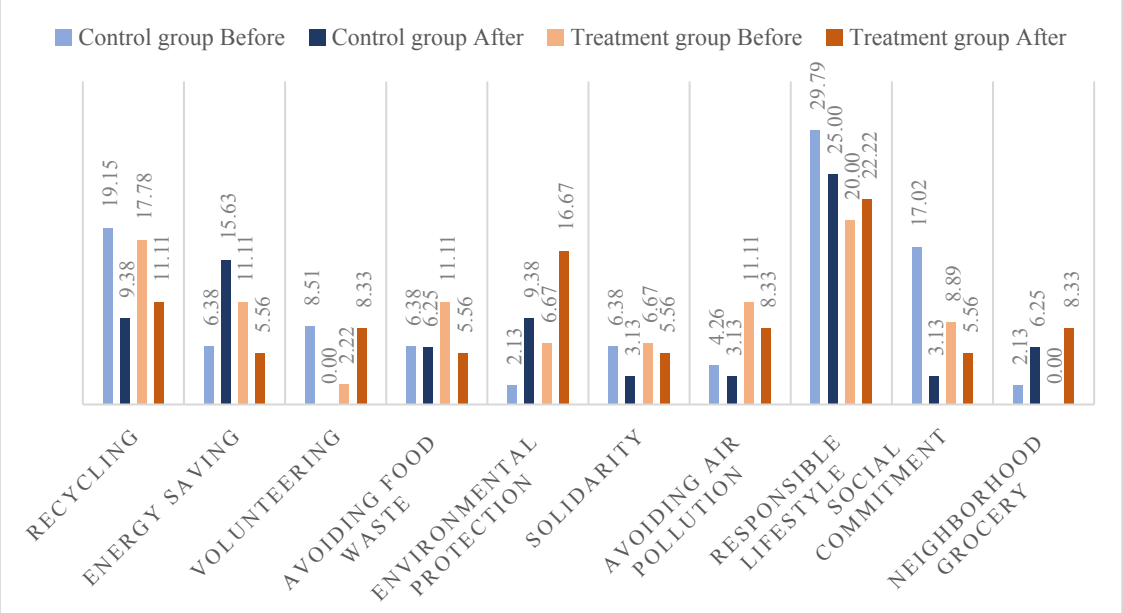
3.3 Participants

The total population consisted of 468 first-year students in Economics and Business Administration. The treatment group consisted of the 311 students who participated in the information and awareness activities; the control group consisted of 157 students who did not participate in the activities. 191 students in the treatment group, and 114 in the control group completed the pre-activity questionnaire. 154 students completed the post-activity questionnaire in the treatment group and 66 students did it in the control group. To analyze our results and compare the students' answers before and after the activity, we asked the students to provide a nickname in their surveys. Most of them were reluctant to do it, and others did not remember the nickname they used in the pre-activity questionnaire when they completed the post-activity survey. Furthermore, we had to eliminate some incomplete questionnaires from our sample. As a result, we finally obtained 99 valid questionnaires from 52 participants that completed the two questionnaires correctly and belonged to the treatment group and 47 to the control group.

4. Results

First, for the item regarding the relative importance of food waste among a range of behaviors, Figure 1 shows the percentage of respondents who identified each behavior as the most important, both before and after the initiative and for both treatment and control groups. For both groups, the most important responsible behavior (i.e., the one most frequently ranked first) was following and maintaining a responsible lifestyle. The other rankings differed across groups and stages. For the control group, the second most important behavior before the activity was recycling (paper, plastic, glass), followed by social commitment; after the activity, this changed to energy saving and recycling, which tied with environmental protection. For the treatment group, the second most important behavior before the activity was recycling, followed by energy saving and avoiding food waste; after the activity, this changed to environmental protection, followed by recycling.

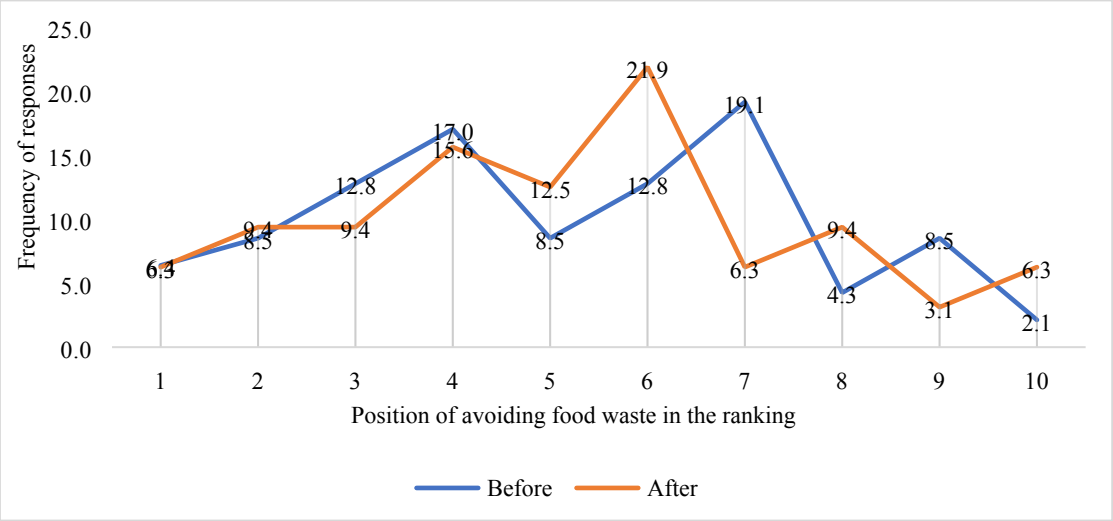
Figure 1. Relative importance of different responsible behaviors (% of respondents ranking each behavior as the most important before and after the activity)



Note: Control group N = 47, treatment group N = 52.

In terms of behaviors for avoiding food waste, the mode values for the control group were 6 and 7 (see Figure 2).

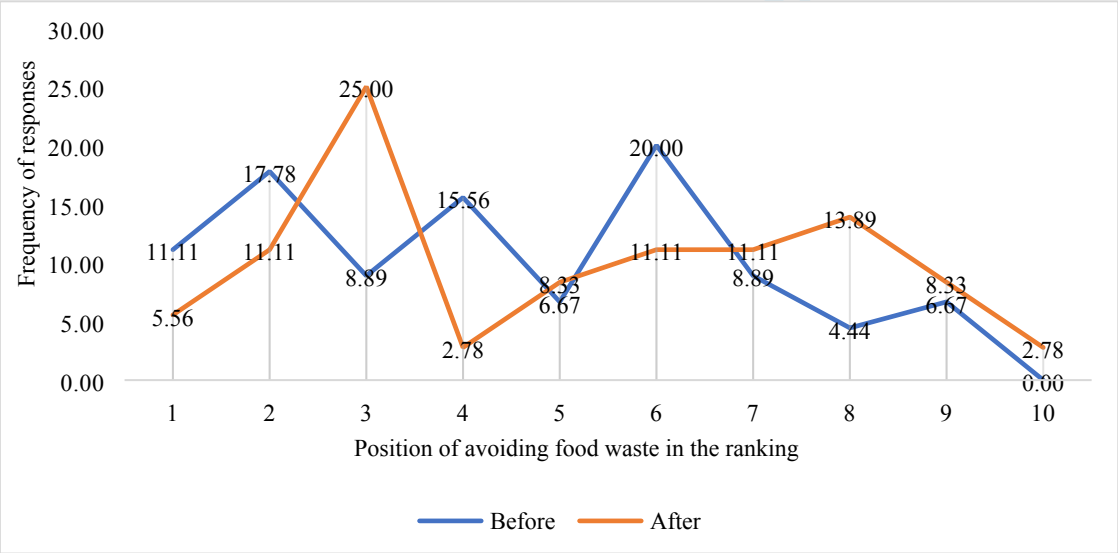
Figure 2. Importance ranking for avoidance of food waste by frequency of responses in the control group (%)



Note: Control group N = 47.

For the treatment group, this measure changed from 6 before the activity to 3 after the activity (see Figure 3). Thus, the treatment group perceived avoiding food waste as more important behavior after the activity than before it.

Figure 3. Importance ranking of avoidance of food waste by frequency of responses in the treatment group (%)



Note: Treatment group N = 52.

Second, because we collected the students' responses in two stages (before and after the initiative), two exploratory factor analyses (EFAs) were conducted in SPSS to explore the unidimensionality of the constructs. This analysis revealed a solution formed by five constructs in each stage: household food waste management skills, awareness of the consequences of food waste, management of leftovers, attitude toward food waste in restaurants, and intention to reduce food waste in restaurants. As the two items for attitude toward food waste at home did not load on the same factor, we decided to treat them separately.

The confirmatory factor analysis (CFA) for the responses before the activity confirmed this solution (see Table 2). However, we decided to eliminate item 5 concerning household food waste management skills, because its loading was below the threshold value of 0.5 (Hulland, 1999; Nunnally, 1978). Cronbach's alpha values and the composite reliability index for all constructs exceeded the minimum acceptable value of 0.7 (Nunnally, 1978; Hair *et al*., 2011), confirming internal consistency, with the exception of management of leftovers, which we therefore decided to analyze separately. The CFA for the responses after the activity confirmed the unidimensionality of the constructs. All the items loaded higher on their respective constructs, the loadings exceeded the threshold value, and the Cronbach's alpha values were higher than 0.7 for all constructs (Table 2).

Table 2. Items loadings and Cronbach's alpha

	Before the activity		**After the activity**	
	Item loading	**Cronbach's alpha**	**Item loading**	**Cronbach's alpha**
Household food waste management skills				
HSKILL1	0.849	0.840	0.842	0.828
HSKILL2	0.713		0.722	
HSKILL3	0.848		0.851	
HSKILL4	0.804		0.618	
HSKILL5	Eliminated		0.569	
Awareness of the consequences of food waste				
AWA1	0.748	0.767	0.800	0.853
AWA2	0.704		0.691	

AWA3	0.644		0.824	
AWA4	0.844		0.876	
Management of leftovers				
LEFT1	0.679	0.554	0.844	0.765
LEFT2	Eliminated		Eliminated	
LEFT3	0.775		0.769	
Attitude toward food waste management in restaurants				
ATTR1	0.598	0.843	0.541	0.899
ATTR2	0.906		0.856	
ATTR3	0.833		0.918	
ATTR4	0.884		0.849	
Intention to reduce food waste in restaurants				
INTR1	0.743	0.737	0.798	0.868
INTR2	0.506		0.804	

An analysis of mean differences was then conducted. Table 3 shows the differences for the treatment group and Table 3 for the control group. Although there was an improvement in the treatment group for almost all the variables, most of these improvements were not significant.

In the treatment group (see Table 3), differences before and after the activity were found for attitude toward food waste in restaurants and in the quantity of dairy products thrown away. Thus, as a result of the activity, the students' attitude toward food waste at restaurants improved and they reduced the quantity of dairy products they threw away at home. We also observed an increase in the means for items 1 and 2 regarding the management of leftovers; after the activity, participants reported eating more leftovers and storing them more often in suitable conditions so that they lasted longer.

Table 3. Mean differences before and after the activity, treatment group

	Before the activity			After the activity			Difference (After−Before)	t-value
	N	Mean	SD	N	Mean	SD		
HSKILL	35	4.639	1.334	35	4.828	1.249	0.189	-0.959
AWA	34	5.479	1.063	34	5.464	1.080	-0.014	0.089
ATTR	34	3.807	1.647	34	4.350	1.469	0.543**	-1.879
INTR	34	5.457	1.215	34	5.214	1.379	-0.243	1.138
ATTH1	35	5.420	1.317	35	5.690	1.261	0.278	-1.152
ATTH2	35	5.580	1.273	35	5.610	1.460	0.028	-0.115
LEFT1	35	5.400	1.432	35	5.650	1.083	0.250*	-1.289
LEFT2	35	3.520	1.553	35	3.880	1.711	0.365*	-1.557

LEFT3	35	5.870	1.205	35	5.730	1.157	-0.135	0.828
FQ	35	2.970	0.971	35	2.750	0.996	-0.222	1.071
BREAD	35	2.780	1.869	35	2.560	1.748	-0.222	0.676
DAIRY	35	1.810	0.856	35	2.170	1.183	0.361**	-1.739
FRUIT	35	2.670	1.414	35	2.610	1.337	-0.056	0.291
VEG	35	2.170	1.028	35	2.170	1.134	0.000	0.000
MEAT	35	1.720	0.882	35	1.640	0.833	-0.083	0.595
FISH	35	1.640	0.798	35	1.670	0.956	0.028	-0.197
BAKE	35	2.060	1.110	35	2.030	1.098	-0.029	0.135
PREC	35	2.400	1.439	35	2.290	1.467	-0.114	0.361

*Note. *p < 0.2; **p < 0.1; ***p < 0.05. HSKILL: household food management skills; AWA: awareness of the consequences of food waste; ATTR: attitude toward food waste in restaurants; INTR: intention to reduce food waste in restaurants; SNR: social norms in restaurants; PNR: personal norms in restaurants; ATTH: attitude toward food waste at home; LEFT: management of leftovers at home; FQ: quantity of food thrown away; BREAD/DAIRY/FRUIT/VEG/MEAT/FISH/BAKE/PREC: quantity of bread/ dairy products/fruit/vegetables/meat/ fish/ baked goods/pre-cooked products thrown away.*

In the control group, there was a decrease in the means for items 1 and 2, indicating both a reduction in these students' perception that avoiding food waste is positive for society and a deterioration in their management of leftover food. However, in this group, the quantity of bread thrown away was reduced (see Table 4).

Table 4. Mean differences before and after the activity, control group

	Before the activity			After the activity			Difference (After−Before)	t-value
	N	Mean	SD	N	Mean	SD		
HSKILL	36	4.715	1.327	36	4.733	1.217	0.018	-0.110
AWA	36	5.667	1.026	36	5.493	1.144	-0.174	0.775
ATTR	37	3.980	1.302	37	4.081	1.570	0.101	-0.462
INTR	35	5.371	1.239	35	5.286	1.441	-0.086	0.396
ATTH1	38	5.36	1.399	38	5.36	1.049	0.000	0.000
ATTH2	38	4.55	1.625	38	3.91	2.045	-0.636*	1.418
LEFT1	38	6.00	0.976	38	5.64	1.529	-0.364*	1.402
LEFT2	38	5.500	1.371	38	5.263	1.309	-0.237	1.070
LEFT3	38	5.789	1.189	38	5.711	0.956	-0.079	0.325
FQ	38	2.921	1.075	38	2.868	1.018	-0.053	0.233
BREAD	38	2.658	1.713	38	2.500	1.689	-0.158	0.547
DAIRY	38	1.868	0.906	38	2.184	1.159	0.316**	-1.671
FRUIT	38	2.605	1.326	38	2.526	1.224	-0.079	0.274
VEG	38	2.105	1.311	38	2.158	1.366	0.053	-0.179
MEAT	38	2.026	1.078	38	2.053	1.524	0.026	-0.119
FISH	38	2.053	1.184	38	2.053	1.272	0.000	0.000
BAKE	38	2.211	1.580	38	2.026	1.365	-0.184	0.557
PREC	38	2.316	1.646	38	2.237	1.240	-0.079	0.298

*Note: *p < 0.2; **p < 0.1; ***p < 0.05. HSKILL: household food management skills; AWA: awareness of consequences; ATTR: attitude toward food waste in restaurants; INTR: intention to reduce food waste in restaurants; SNR: social norms in restaurants; PNR: personal norms in restaurants; ATTH: attitude toward food waste at home; LEFT: management of leftovers at home; FQ: quantity of food thrown away; BREAD/DAIRY/FRUIT/VEG/MEAT/FISH/BAKE/PREC: quantity of bread/dairy products/fruit/vegetables/meat/fish /baked goods/pre-cooked products thrown away.*

Regarding differences between those who took part in the activity and those who did not, the improvement in management of leftovers by incorporating them into new dishes was greater for the treatment group. The difference before and after the activity in the means for item 1 regarding attitude toward food waste at home was greater for the control group (see Table 5).

Table 5. Mean differences between treatment and control groups

	Control group			Treatment group			Difference	t-
	N	Mean	SD	N	Mean	SD	(Treat.−Control)	value
HSKILL	36	0.018	0.986	36	0.189	1.181	0.171	-0.666
AWA	36	-0.174	1.344	35	-0.014	0.949	0.159	-0.576
ATTR	37	0.101	1.334	35	0.543	1.709	0.442	-1.226
INTR	35	-0.086	1.280	35	-0.243	1.262	-0.157	0.517
ATTH1	38	-0.237	1.364	36	0.278	1.446	0.515*	-1.575
ATTH2	38	-0.079	1.496	36	0.028	1.444	0.107	-0.312
LEFT1	38	0.281	1.746	36	0.111	1.260	-0.170	0.456
LEFT2	38	-0.438	1.813	36	0.389	1.931	0.826**	-1.813
LEFT3	38	-0.219	1.237	36	-0.139	1.222	0.080	-0.267
FQ	38	-0.053	1.394	36	-0.222	1.245	-0.170	0.551
BREAD	38	-0.158	1.779	36	-0.222	1.973	-0.064	0.147
DAIRY	38	0.316	1.165	36	0.361	1.246	0.045	-0.162
FRUIT	38	-0.079	1.776	36	-0.056	1.145	0.023	-0.067
VEG	38	0.053	1.815	36	0.000	1.309	-0.053	0.142
MEAT	38	0.026	1.365	36	-0.083	0.841	-0.110	0.413
FISH	38	0.000	1.356	36	0.028	0.845	0.028	-0.105
BAKE	38	-0.184	2.038	36	-0.029	1.248	0.156	-0.389
PREC	38	-0.079	1.634	36	-0.114	1.875	-0.035	0.086

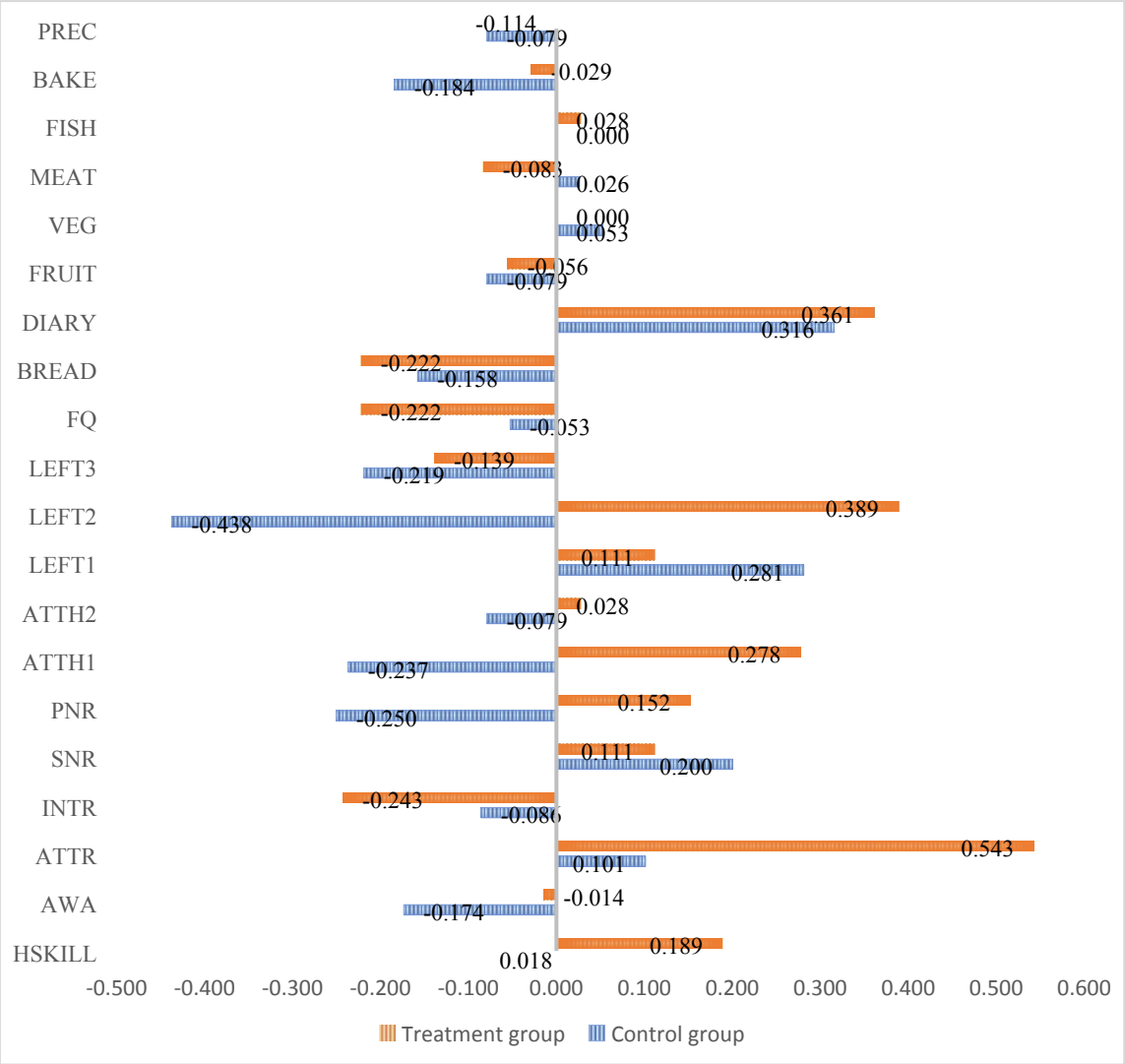
*Note: *p < 0.2; **p < 0.1; ***p < 0.05. HSKILL: household food management skills; AWA: awareness of consequences; ATTR: attitude toward food waste in restaurants; INTR: intention to reduce food waste in restaurants; SNR: social norms in restaurants; PNR: personal norms in restaurants; ATTH: attitude toward food waste at home; LEFT: management of leftovers at home; FQ: quantity of food thrown away; BREAD/DAIRY/FRUIT/VEG/MEAT/FISH/BAKE/PREC: quantity of bread/dairy products/fruit/ vegetables/meat/fish/ baked goods/pre-cooked products thrown away.*

Figure 4 represents graphically the mean differences of all the variables used in this study for both groups (treatment and control). Waste of dairy products reduced in both groups, but waste of most other food types increased, although the differences for vegetables, meat and fish were small. The other variables improved after the activity in the treatment group, except for intention to reduce food waste in restaurants, awareness of consequences and item 3 of leftovers management. Thus, there was an improvement

(albeit not a significant one) in the participants' eating of leftovers (item 2 of leftovers management) and incorporating them into new dishes (item 1 of leftovers management), their attitude toward food waste, their perceptions about household food waste management and their attitude toward food waste in restaurants, with the largest improvement shown in the last of these.

From these results, it can be cautiously concluded that the teaching initiative on the importance of avoiding food waste has been successful for university students, since it raised their awareness about the food waste consequences and improved their perception about household food waste management, but it cannot be concluded that the initiative has been totally effective because the real behavior of the student in relation to food waste has not been controlled afterwards. Even so, this study contributes to the literature on food waste by addressing the lack of research that measures the effectiveness of different initiatives and campaigns (Pinto *et al*., 2018; Schanes *et al*., 2018), and can guide other researchers to design future food waste preventive initiatives.

Figure 4. Mean differences between treatment and control groups

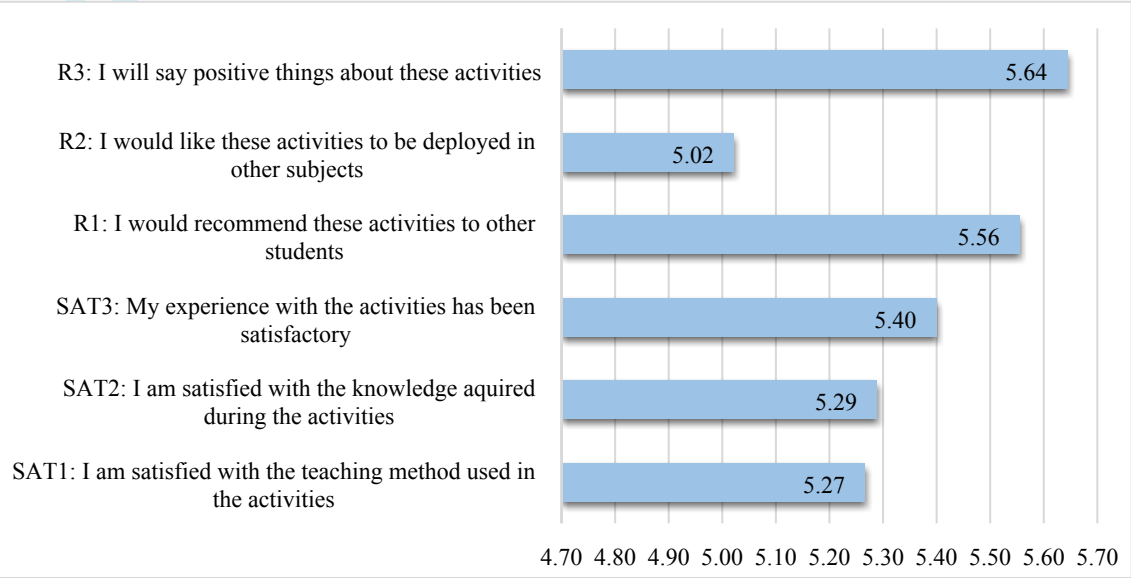


Note. HSKILL: household food management skills; AWA: awareness of consequences; ATTR: attitude toward food waste in restaurants; INTR: intention to reduce food waste in restaurants; SNR: social norms in restaurants; PNR: personal norms in restaurants; ATTH: attitude toward food waste at home; LEFT: management of leftovers at home; FQ: quantity of food thrown away; BREAD/DAIRY/FRUIT/VEG/MEAT/FISH/BAKE/PREC: quantity of bread/dairy products/fruit/vegetables/meat/fish/baked goods/pre-cooked products thrown away.

Finally, as described above, we asked the participants about their satisfaction (SAT1, SAT2, SAT3) with the activity and their intention to recommend (R1, R2, R3). In general, the students were satisfied with this kind of activity and were willing to recommend it, with means ranging from 5 to 6 on a 7-point Likert-scale (see Figure 5). The intention to say positive things about the activity and to recommend it to other students was particularly high. These results will encourage teaching staff in marketing subjects to

implement similar activities in future courses, with appropriate changes to increase active student participation.

Figure 5. Means for satisfaction with the activity and intention to recommend



5. Discussion

The problem of food waste has become increasingly important over the last decade. Wasting food runs contrary to the 12th SDGs that we must all work toward. Raising awareness of the problem has been shown to improve knowledge of the consequences of food waste and to increase intention to curb waste behaviors (Visschers *et al.*, 2016; Principato *et al*., 2015).

Initiatives developed to raise awareness of the problem of food waste are numerous and diverse, but their impact on students' awareness and behavior has rarely been measured (Stöckli *et al*., 2018; Young *et al*., 2017). This study addresses how useful an information and awareness-raising initiative is to raise undergraduate students' awareness on the problem of food waste and to reduce their food waste behavior, designing and administering questionnaires before and after it.

Given the low response rate, our results must be interpreted with caution. However, there is evidence that the information sessions on the main causes and consequences of food waste and key tips for avoiding food waste were successful. Specifically, our results show changes in the students' perceptions of their behaviors in managing leftovers at home, with greater efforts to eat leftovers, to use them to prepare other dishes, and to reduce the amount of dairy produce thrown away. The participants' attitude toward food waste in restaurants also improved. Most of the variables related to food waste concern and awareness of food waste consequences improved because of the impact of the teaching initiative on the treatment group. Although the results were not significant, there was an improvement in the participants' management of leftovers and incorporation of them into new dishes. Students' perceptions and attitude toward food waste at home also improved, but the biggest change was in their attitude toward food waste in restaurants. This last result may be because young people in restaurants perceive pressure from others and are, therefore, more likely to feel ashamed if they leave food on the plate.

Specifically, waste of dairy products reduced in both groups, although it increased for most other food types. This may be because the consumption of dairy products (including yogurt and cheese) is relatively common, stable and recurrent, which allows it to be managed better.

These results, although limited, are relevant, and the objective of this study is achieved. Therefore, it can be concluded that the information and awareness activities on the problem of food waste were moderately effective, at least in terms of student's perceptions, since they perceived that the initiative caused an improvement in their level of food waste awareness and their behavior regarding the management of leftovers at home and a reduction in the quantity of dairy products wasted. This is consistent with the findings of previous initiatives conducted in higher education institutions in which similar

activities had a positive impact on students' behavior (Feijoo and Moreira, 2020; Ahmed *et al.,* 2018).

Furthermore, the combination of different types of interventions (including information/education, prompts, nudging and games) also appear to be the most promising method (Stöckli *et al*., 2018; Soma *et al*., 2021), as young people's knowledge of the serious consequences of food waste does not necessarily discourage them from generating such waste. More research is needed on the effectiveness of different initiatives for curbing food waste.

5.1 Academic and practical implications

Our study contributes to educational institutions' function of informing and training students in more responsible consumption patterns (Sibbel, 2009), particularly in the context of marketing, a discipline that has traditionally appeared to encourage consumption. It also contributes to the literature on food waste by using an experimental design to measure real changes in awareness, attitudes and behaviors regarding food waste, in contrast to qualitative studies based solely on students and teachers' perceptions. In this way, our study contributes to food waste research by providing evidence of the usefulness of an initiative conducted in a higher education institution with the aim of increasing awareness and changing behavior regarding food waste. Awareness activities seem to be promising, as they led to an improvement in students' perceptions about their behaviors regarding the management of leftovers.

Not only the results but also the procedures of this study can serve as a basis for the design of future initiatives, thereby answering the calls of food waste researchers (Aschemann-Witzel *et al*., 2015; 2017). On the basis of our findings, the study encourages behavioral researchers on food waste to design further initiatives of this type, combining information

activities about food waste and its consequences with key tips on how to avoid and reduce food waste. The authors note that the participation of students in an initiative of this type is likely to be greater if they are actively involved in its design and given some responsibility for carrying it out with their classmates.

6. Conclusions

It is taken for granted that universities must contribute to achieving the SDGs (United Nations, 2020) by educating and training their students in favor of sustainability. Here, an initiative was designed to inform and educate students about the problem of food waste and its consequences, offering some key methods and prompts for reducing their own food waste. Before and after the activities, a questionnaire was administered to analyze whether the activities had influenced the students' perceptions and behaviors in a way that allowed us to prove its usefulness.

The objective of this study was achieved since the students perceived that the information and awareness activities had caused an improvement in their food waste-related behavior and a reduction of the dairy products wasted at home. However, these results should be interpreted with caution, given certain limitations of the study and the circumstances under which it was conducted.

One of these limitations is the low response rate. In particular, it was difficult to analyze the questionnaire of all the participants, since some of them did not submit their responses under a nickname. Despite their teachers explaining that they should do this to guarantee their anonymity, and that they should remember their nickname and reuse it for the second questionnaire, many of the students did not follow the recommendations. Future initiatives should seek solutions to this problem, perhaps by offering a reward or gift to stimulate student interest, a technique that has been helpful in similar contexts (Soma *et*

al., 2021). The activity could also be made more interesting to the students by involving them in its design and even its implementation (Kim *et al*., 2020). Another limitation of this study is due to the COVID-19 pandemic and the resulting lockdown. These circumstances meant that the questionnaires collected during March 2020 had to be completed online, not in class like the rest. This extraordinary situation is also likely to have reduced the response rate, as students were facing the challenge of finding new ways to attend classes, as well as growing concern about the spread of the disease among family and friends.

It should be noted that the data reflect the perception that students have of their behavior, not actual behavior. This involves some limitations, such as the fact that students may not be completely aware of their behaviors, and the fact that their answers may be influenced by social desirability bias and peer pressure due to their classmates' behavior (Malhotra, 2019). Therefore, it cannot be firmly stated that this initiative has been effective and future research should try to check for the impact of teaching initiatives on students' food waste behavior by using measures such as food quantity in kilograms or observed behavior.

The study encourages the research community to repeat this type of initiative, with the suggested improvements, in order to train and educate young people in making more responsible personal and professional decisions. Furthermore, it would be interesting to conduct an additional questionnaire with a time lapse after the last activity so researchers could see whether the initiative is useful to change awareness and behavior in the long run.

References

Ahmed, S., Shanks, C. B., Lewis, M., Leitch, A., Spencer, C., Smith, E. M. and Hess, D. (2018), "Meeting the food waste challenge in higher education". *International Journal of Sustainability in Higher Education*, Vol. 19, No. 6, pp. 1075-1094.

Aschemann-Witzel, J., de Hooge, I. E., Rohm, H., Normann, A., Bossle, J. B., Grønhøj, A. and Oostindjer, M. (2017), "Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste e A multiple case study". *Journal of Cleaner Production*, Vol. 155, pp.33-45. http://dx.doi.org/10.1016/j.jclepro.2016.11.173.

Aschemann-Witzel, J., de Hooge, I., Amani, P., Bech-Larsen, T. and Oostindjer, M. (2015), "Consumer-Related Food Waste: Causes and potential for action". *Sustainability*, Vol. 7, pp. 6457-6477. https://doi.org/10.3390/su7066457.

Balonas, S. and Marques, S. (2018), Food waste in higher education institutions. Smaller Eyes than Belly Movement. In Social Marketing: Rebels with a Cause (3rd ed.) by Hastings, G. and Domegan, C. Routledge. https://doi.org/10.4324/9781315648590.

Bhattacherjee, A., Limayem, M. and Cheung, C. M. K. (2012), "User switching of information technology: A theoretical synthesis and empirical test". *Information & Management*, Vol. 49, pp. 327–333.

Chiba, M., Sustarsic, M., Perriton, S., and Edwards Jr, D. B. (2021), "Investigating effective teaching and learning for sustainable development and global citizenship: Implications from a systematic review of the literature". *International Journal of Educational Development*, Vol. 81, 102337.

Devin, B. and Richards, C. (2018), "Food Waste, Power, and Corporate Social Responsibility in the Australian Food Supply Chain". *Journal of Business Ethics*, Vol. 150, pp. 199–210. https://doi.org/10.1007/s10551-016-3181-z.

Diaz-Ruiz, R., Costa-Font, M. and Gil, J. M. (2018), "Moving ahead from food-related behaviours: an alternative approach to understand household food waste generation". *Journal of Cleaner Production*, Vol. 172, pp. 1140-1151. https://doi.org/10.1016/j.jclepro.2017.10.148.

Feijoo, G. and Moreira, M. T. (2020), "Fostering environmental awareness towards responsible food consumption and reduced food waste in chemical engineering students". *Education for Chemical Engineers*, Vol. 33, pp. 27-35.

Filho, W. L., Salvia, A. L., Davis, B., Will, M. and Moggi, S. (2021), Higher education and food waste: assessing current trends. *International Journal of Sustainable Development and World Ecology*. https://doi.org/10.1080/13504509.2020.1865474.

Girotto, F.; Alibardi, L. and Cossu, R. (2015), "Food waste generation and industrial uses: A review". *Waste Management*, Vol. 45, pp. 32-41. https://doi.org/10.1016/j.wasman.2015.06.008.

Hair, J. F., Ringle, C. M. and Sarstedt, M. (2011), "PLS-SEM: Indeed, a silver bullet". *Journal of Marketing Theory and Practice*, Vol. 19, No. 2, pp. 139–151.

Hübscher, C., Hensel-Börner, S. and Henseler, J. (2021), Social marketing and higher education: partnering to achieve sustainable development goals. *Journal of Social Marketing*, Vol. 12, No. 1, pp. 76-104. https://doi.org/10.1108/JSOCM-10-2020-0214.

Hulland, J. (1999), "Use of Partial Least Squares (PLS) in Strategic Management Research: A Review of Four Recent Studies". *Strategic Management Journal*, Vol. 20, pp. 195-204. https://doi.org/10.1002/.

Ilakovac, B., Voca, N., Pezo, L. and Cerjak, M. (2020), "Quantification and determination of household food waste and its relation to sociodemographic characteristics in Croatia". *Waste Management*, Vol. 102, pp. 231-240.

Kim, J., Rundle-Thiele, S., Knox, K., Burke, K. and Bogomolova, S. (2020), "Consumer perspectives on household food waste reduction campaigns". *Journal of Cleaner Production*, Vol. 243, 118608. https://doi.org/10.1016/j.jclepro.2019.118608.

Larrán, M., Herrera, J., Calzado, Y., Andrades, J. A. (2016), "Proposal for measuring sustainability in universities: a case study of Spain". *International Journal of Sustainability in Higher Education*, Vol. 17; No. 5, pp. 671-697. https://doi.org/10.1108/IJSHE-03-2015-0055.

Lorenz, B. A. S., Hartmann, M. and Langen, N. (2017). "What makes people leave their food? The interaction of personal and situational factors leading to plate leftovers in canteens". *Appetite*, Vol. 116, pp. 45-56.

Maher, J. and Burkhart, S. (2017), "Experiential learning for engaging nutrition undergraduates with sustainability". *International Journal of Sustainability in Higher Education*, Vol. 18, No. 7, pp. 1108-1122.

Malhotra, N. K. (2019), Marketing research: an applied orientation (7th Edition). England. Pearson Edt.

Mallinson, L. J., Russell, J. M. and Barker, M. E. (2016), "Attitudes and behaviour towards convenience food and food waste in the United Kingdom". *Appetite*, Vol. 103, pp. 17-28. https://doi.org/10.1016/j.appet.2016.03.017.

MAPAMA. (2018), Informe del consumo de alimentación en España 2017. Ministerio de Agricultura, Pesca y Alimentación. Madrid. Available online:

https://www.mapa.gob.es/images/es/informeanualdeconsumoalimentario2017_tcm30-456186.pdf. (Accessed on October 2018).

Menon, S. and Suresh, M. (2020), "Synergizing education, research, campus operations, and community engagements towards sustainability in higher education: a literature review". *International Journal of Sustainability in Higher Education*, Vol. 21, No. 5, pp. 1015-1051.

Morone, P., Falcone, P.M., Imbert, E., and Morone, A. (2018), Does food sharing lead to food waste reduction? An experimental analysis to assess challenges and opportunities of a new consumption model. *Journal of Cleaner Production*, Vol. 185, pp. 749-760. https://doi.org/10.1016/j.jclepro.2018.01.208.

Nunnally, J. C. (1978), Psychometric theory (2nd ed.). New York: McGraw-Hill.

Parfitt, J., Barthel, M. and Macnaughton, S. (2010), "Food waste within food supply chains: Quantification and potential for change to 2050". *Philosophical Transactions of the Royal Society*, Vol. 365, pp. 3065–3081.

Pinto, R. S., dos Santos Pinto, R. M., Melo, F. F. S., Campos, S. S. and Cordovil, C. M. D. S. A. (2018), "Simple awareness campaign to promote food waste reduction in a University canteen". *Waste Management*, Vol. 76, pp. 28-38.

Principato, L., Secondi, L. and Pratesi, C. A. (2015), "Reducing food waste: An investigation on the behaviour of Italian youths". *British Food Journal*, Vol. 117, No. 2, pp. 731-748. https://doi.org/10.1108/BFJ-10-2013-0314.

Schanes, K., Dobernig, K. and Gözet, B. (2018), "Food waste matters-A systematic review of household food waste practices and their policy implications". *Journal of Cleaner Production*, Vol. 182, pp. 978-991.

Sibbel, A. (2009), "Pathways towards sustainability through higher education". *International Journal of Sustainability in Higher Education*, Vol. 10, No. 1, pp. 68-82.

Soma, T., Li, B. and Maclaren, V. (2021), "An evaluation of a consumer food waste awareness campaign using the motivation opportunity ability framework". *Resources, Conservation & Recycling*, Vol. 168, https://doi.org/10.1016/j.resconrec.2020.105313.

Soma, T., Li, B. and Maclaren, V. (2020), "Food waste reduction: a test of three consumer awareness interventions". *Sustainability*, Vol. 12, p. 907, https://doi.org/10.3390/su12030907.

Stancu, V., Haugaard, P. and Lähteenmäki, L. (2016), "Determinants of consumer food waste behaviour: Two routes to food waste". *Appetite*, Vol. 96, pp. 7-17.

Stöckli, S., Niklaus, E. and Dorn, M. (2018), "Call for testing interventions to prevent consumer food waste". *Resources, Conservation & Recycling*, Vol. 136, pp. 445–462. https://doi.org/10.1016/j.resconrec.2018.03.029.

United Nations. (2020). Available online: https://www.un.org/sustainabledevelopment/es/sustainable-consumption-production/. (Accessed on April 2020).

Visschers, V.H.M., Wickli, N. and Siegrist, M. (2016), "Sorting out food waste behaviour: A survey on the motivators and barriers of self-reported amounts of food waste in households". *Journal of Environmental Psychology*, Vol. 45, pp. 66-78.

Wang, S., Lin, S. and Li, J. (2018), "Exploring the effects of non-cognitive and emotional factors on household electricity saving behavior". *Energy Policy*, Vol. 115, pp. 171-180.

Wang, Z., Zhang, B., Yin, J. and Zhang, X. (2011), "Willingness and behavior towards e-waste recycling for residents in Beijing city, China". *Journal of Cleaner Production*, Vol. 19, No. 9-10, pp. 977-984.

Young, C. W., Russell, S. V., and Barkemeyer, R. (2017), "Social media is not the 'silver bullet' to reducing household food waste, a response to Grainger and Stewart". *Resources, Conservation and Recycling*, Vol. 122, pp. 405-406.

Zamri, G. B., Azizal N. K. A., Nakamura, S., Okada, K., Nordin, N. H., Othman, N., Akhir, F. N. MD., Sobian, A., Kaida, N. and Hara, H. (2020), "Delivery, impact and approach of household food waste reduction campaigns". *Journal of Cleaner Production*, Vol. 246, p. 118969. https://doi.org/10.1016/j.jclepro.2019.118969.

Zeithaml, V. A., Berry, L. L. and Parasuraman, A. (1996), "The behavioral consequences of service quality". *Journal of Marketing*, pp. 31–46.

Zhang, B., Lai, K-H., Wang, B. and Wang, Z. (2019), "From intention to action: How do personal attitudes, facilities accessibility, and government stimulus matter for household waste sorting?". *Journal of Environmental Management*, Vol. 233, pp. 447–458.

About the authors

Elena Fraj-Andrés is an Associate Professor at the University of Zaragoza (Spain). Her research interests are focused on ecological consumer behaviour, environmental marketing strategy and sustainable marketing in education.

Carolina Herrando is an Assistant Professor in the Department of Marketing and Market Research at the University of Zaragoza in Spain. Her research interests are focused on the

online consumer behaviour and electronic commerce, with a particular focus on social commerce websites, engagement and the optimal experience or flow state.

Laura Lucia-Palacios is an Associate Professor in the Department of Marketing at the University of Zaragoza in Spain. Her research interests are focused on customer experience management, new technologies, franchising and pioneering advantages.

Raúl Pérez-López is an Assistant Professor in the Department of Marketing at the University of Zaragoza, in Spain. His research interests are focused on consumer behavior, customer experience management and e-marketing.

Appendix

Measurement scales

Rank the following behaviors according to their importance, ranging from 1st (most important) to 10th (least important):	
Recycling (paper, plastic, batteries, containers, clothing, etc.)	
Energy saving (lighting, water, gas, etc.)	
Volunteering activities (sharing, giving away)	
Avoiding food waste	
Environmental protection	
Solidarity	
Avoiding air pollution	
Following a responsible lifestyle	
Active social commitment to my community	
Neighborhood grocery shopping	
Quantity of food thrown away	
How much food do you think you throw away at home in a 7-point scale, where 1 is "nothing" and 7 is "a lot"?	
How often do you throw away the following types of food in a 7-point scale, being 1 "never" and 2 "very often"?	
BREAD	Bread, cereals
DAIRY	Dairy products, yogurts, and cheese
FRUIT	Fruits
VEG	Vegetables
MEAT	Meat
FISH	Fish
BAKERY	Bakery pieces
PREC	Pre-cooked dishes
Household food waste management skills	
How would you score the following skills according to your performance in a 7-point scale, where 1 means "not at all skilled" and 7 "very skilled"?	
HSKILL1	Meal planning
HSKILL2	Shopping planning (shopping list, checking of food stored, etc.)
HSKILL3	Shopping the adequate pieces of food and the adequate quantity to prepare meals and consume them at home
HSKILL4	Cooking/meal preparation
HSKILL5	Keeping and reusing leftovers
Leftovers' management	
LEFT1	The leftovers are usually eaten as such or just reheated when used again
LEFT2	The leftovers are usually transformed into a different dish by adding some ingredients before eating them
LEFT3	The leftovers are stored in appropriate conditions so they will last
Awareness of consequences of food waste	
AWA1	I think food waste has some effects on the environment
AWA2	I think that food waste has some effects on the society
AWA3	Nature resources will be excessive consumed if we do not do household waste sorting
AWA4	The life of descendants would be badly influenced if we do not do household waste sorting
Attitude toward food waste at home	
ATTH1	Avoiding food waste makes me feel satisfied
ATTH2	I think that avoiding food waste contributes to society positively
Attitude toward food waste in the restaurant	
ATTR1	In the restaurant, not eating everything up is a mistake

ATTR2	In the restaurant, not eating everything up is irresponsible
ATTR3	In the restaurant, not eating everything up is unacceptable
ATTR4	In the restaurant, not eating everything up is inappropriate
Intentions to reduce food waste in the restaurant	
INTR1	I generally try to return an empty plate
INTR2	I generally try not to waste any food in the restaurant
Satisfaction with the activity	
SAT1	I am satisfied with the teaching method used in the activities
SAT2	I am satisfied with the knowledge acquired during the activities
SAT3	My experience with the activities has been satisfactory
Recommendation intentions	
R1	I would recommend these activities to other students
R2	I would like these activities to be deployed in other subjects
R3	I will say positive things about these activities