Food and Sustainability: An Emerging Subject in Sustainable Environmental Sciences Education Applying to the e-Learning Environment

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Abstract The global food system makes a significant contribution to climate change, affecting greenhouse gas emissions and other major environmental impacts, along the entire food chain. Individual food consumption is an important part of the production-consumption chain, because consumers make the final choice of the goods and services they consume, and their lifestyles determine how they influence sustainability practices. Simultaneously, there is an increasing concern for the environment issues and an increasing demand for naturalistic icons or organic production, free-range farming and unadulterated processing. This work addresses the imperative to address sustainability in food consumer sciences education, due to the multidisciplinary nature of consumer food studies, by applying online education programmes. The rational for e-learning approach is the fact that, advances in information and communication technologies have had a tremendous impact on the format and on the approaches to teaching and learning.

Keywords Activity theory · Diet · Environmental impact · Food safety, food security · Public health

The Relevance of "Food Dimension" for Sustainable Consumption

Food, health and environment are dimensions that are interchangeable (Loo et al. 2017). The Food and Agriculture Organization of the United Nations (FAO 2012a, p. 7) considers health aspects to be linked with sustainability in the context of food

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and defines sustainable diets as: "diets with low environmental impacts which contribute to food and nutrition security and to a healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources".

In fact, during the last two decades, there has been a widespread of consumer concern and distrust over food products and production methods in the agriculture and in the food industry. These attitudes tend to be reinforced by the absence of face-to-face contact between buyers and sellers during the process of food selection, leaving the burden of assessing product quality entirely in the consumers' hands. Shopping under these circumstances is a stressful activity, while the lack of trust in agricultural and industrial methods of production and food quality gives rise to feelings of uncertainty and insecurity (Cunha and Moura 2004). In this context, there has been an interest in the "return to nature", remerging new food production/consumption patterns, following a sustainable consumption approach based on the environmental, nutritional and/or health qualities and ethical concerns (Murdoch and Miele 1999), such as: (i) food preferences (meat consumption), (ii) organic foods, (iii) local foods, and (iv) food waste concern.

The purpose of this paper is to describe the most important food consumption patterns that downside the globalization process, evaluate the main challenges related to them and discuss their impact on sustainable consumption. This analysis may contribute to the development of sustainable environmental sciences courses by incorporating the sustainable food consumption perspective in their curricula. The emergency of applying e-learning is considered, taking into account that e-learning is becoming widely accepted in formal and non-formal education proving to have the potential to be effective in expanding education for sustainability (Azeiteiro et al. 2015).

New Trends in the Food Consumption

Food Preferences: Meat Consumption

Over the past decades, rapid changes in diets and lifestyles have occurred with industrialisation, urbanisation, economic development and market globalisation. All these drivers promote the process of diet Westernization among other cultures/countries, namely towards upper-to middle-income developing economies (Drewnowski and Popkin 1997), and even in populations having rich and deeply rooted culinary traditions, such as Japan (Morinaka et al. 2013) or Southern Europeans countries (Varela-Moreiras et al. 2010). This dietary pattern, belonging to the common eating habits in developed countries of Western Europe and the United States of America of America, is characterized by a high consumption of red

meat, refined grains, processed meat, dairy products, processed and artificially sweetened foods, and salt, with minimal intake of fruits, vegetables, fish, legumes, and whole grains (Cordain et al. 2005).

In fact, the available food consumption of meat is increasing, with the biggest increases couriers in developing countries. Developing countries between 1969/1971 and 2005/2007 have accounted for a large share of this increase in food consumption per capita (kcal/person/day) from 11 to 28, contrasting with the 63 to 80 increase for industrial countries over this period (FAO 2006). In addition, the most developing countries especially in China and Brazil have largely completed the transition to animal products: meat and livestock products (eggs and dairy foods). On other hand, in both developing and industrial countries (including again China) the consumption of pulses, roots and tubers between declined between 1963 and 2003 (Kearney 2010). There is also a great consensus in the scientific community about changing the Western diet to have a positive outcome for both people's health and environment (Friel et al. 2009).

Diets that increase the risk of many chronic non communicable diseases (NCDs), which mainly comprise cardiovascular diseases, diabetes, cancers, chronic respiratory diseases, obesity, and osteoporosis, are relatively high in total fat, saturated fats, sugar, salt, alcohol, refined grains and foods of animal origin, whereas diets that protect against chronic diseases are relatively high in minimally processed grains, legumes, fibre, vegetables, fruits and foods of plant origin (Popkin and Du 2003). Reducing intake of meat (particularly red meat), dairy products and eggs in high income countries will promote significant health benefits, as diets rich in saturated fats (primarily from higher meat and milk consumption) are associated with an increased risk of cardiovascular diseases and stroke, colorectal cancer and diabetes (Pan et al. 2012).

On the other hand, meat tend to have higher environments impact due to greenhouse gas (GHG) emissions and their inefficiency of production. According to FAO, the livestock production is estimated to be responsible for 18% of the global emission of GHG (a higher share than transport sector), promoting global warming temperatures, with the main contributor being CH_4 from enteric fermentation, N_2O from manure and fertilizer, and CO_2 from land use change and agriculture energy use (Steinfeld et al. 2006). Raising and feeding livestock introduces an additional trophic level in the food chain, and each trophic level leads to losses of energy and nutrients, reducing the efficiency of the production (Nemecek et al. 2016). In this context, ruminants (cattle, sheep and goats) account for a large share of total livestock emissions, because they are less efficient in converting feed into useful products than monogastrics, like pigs and poultry. Moreover, livestock is by far the single largest land use sector in our planet, as it accounts for 70% of global agriculture land, and 30% of the global land surface, contributing as a key factor in deforestation and land degradation, particularly in Latin American (Steinfeld et al. 2006). As livestock production intensifies, it depends less on locally available feed resources (e.g. unconsumed portions of household food, crop residues) but increasingly on feed concentrates (cereals, oil seeds), that are traded domestically and internationally, leading to an intensification of the existing cropped area

(Thornton 2010). Moreover, livestock production is a key player in increasing water use, accounting for over 8% of global human water use, mostly for the irrigation of feed crops. It is also considered the largest agricultural source of water pollution, mostly from animal waste, antibiotics and hormones and fertilizers and pesticides used for feed crops. All these factors contribute to the livestock sector being the leading player in the reduction of biodiversity.

Different studies suggested that respecting the dietary recommendations for a healthy diet would reduce the overall environmental impacts in developed countries particularly in terms of GHG emission and land use. The change would imply a reduction of meat consumption and would lead towards a plant-based diet (Davis et al. 2010; Westhoek et al. 2014). Nevertheless, the environmental impacts of plant-based food items may vary according to growing practices and climatic conditions.

Organic Foods

Organic agriculture is a production management system that uses methods safeguarding the environment from some production stages trough handling and processing. It favours renewable resources, recycling and returning nutrients to the soil found in waste products. With regard to livestock, organic agriculture places particular emphasis on animal welfare and the use of natural foodstuffs. Under the organic system, the focus is on maintaining and improving the overall health of individual farms' soil-microbe-plant-animal system (following a holistic approach), which affects present and future yields (IFOAM 2008). As result, the emphasis in this process is on using the environment's own systems for controlling pests and diseases in growing crops and rearing livestock thus avoiding the use of synthetic pesticides, herbicides, synthetic fertilisers, growth promoters and gene manipulation, as well as the prophylactic use of antibiotics and the zootechnical use of hormones. That is, the resource "nature" is manipulated to encourage processes, which help raise and maintain farm productivity. Concisely, what differentiates organic agriculture from other non-organic agricultural production methods is the focus on management. In organic agriculture, management is directed towards preventing problems, while stimulating processes, which assist in nutrition and pest management (FAO 1998). This means that organic agriculture has generically beneficial impacts on the environment and animal welfare compared to conventional agriculture. It demands lower energy requirements and gives a clear benefit for biodiversity on agricultural land (Tuomisto et al. 2012). The main challenge in organic agriculture is to increase yields without causing harm to the environment. Since its yields tend to be lower, it means that more land is needed to produce the same amount of food. The main reason for low yields in organic farms are soil nutrient deficiencies and problems with pests, diseases and weeds (Tuomisto et al. 2012).

Focusing our analysis on the European continent, organic food and farming has continued to grow across Europe. Since 1985, in Europe, the total area of land under organic production increased from 0.1 million to 12.7 million hectares by 2015 (which is 25% of the world's organic agriculture land), and in the EU-28 it increased to 11.2 million hectares, an increase of 7.8% over 2014. Within the EU, organic farming is regulated by the European Council Regulation No 834/2007 (EC 2007), which sets the basis for national standards in the EU. All organic producers are inspected by organic inspection bodies, which may be private or managed by government. Retail sales of organic products totalled around 29.8 billion euros in 2015, an increase of 13% over 2014. Within the EU-28, retail sales of organic products totalled approximately 27.1 billion euros, an increase of 12.6% over 2014. The highest per capita consumption in the world with more than 170 euros is found in Switzerland, Denmark, Luxembourg and Sweden (Willer and Lernourd 2017).

Burning in mind these data, a question is imposed: what are the main drivers that motivate Western consumers, particularly Western European consumers for organic food consumption? It is generally accepted that the market of organic products is driven by three primary consumer concerns: (i) concern for personal health (the way that food is related to health), (ii) consumer fears regarding conventional food safety (linked to the health concern), and (iii) concern for the environmental and animal welfare (Cunha and Moura 2004). Even though some studies point out that there is significant motivation to buy organic food on environmental or ethical grounds, most researchers indicates that the consumption of organic foods is related to a decreasing confidence in the quality of conventional foods, perceived by consumers as "unnatural", and the increasing concern for health (Magnusson et al. 2003).

The health public concern is part of a widespread anxiety among consumers about the quality of food one eats. Even through there is food safety control, systems and legislation have been put in place throughout the EU to minimize the risk to consumers' health (Mil-Homens et al. 2016). Since the middle 1980 s, most Western European countries have faced various food safety incidents that have led to increasing public unease about health and safety of modern methods of production (Cunha et al. 2010). Food hazards amplified by the media (Kasperson et al. 2003) could be directly related with food crisis (e.g. BSE in cows, avian flu) or lifestyle hazards, such as eating disorders (Moura and Cunha 2009). European consumers may perceive a reduction in pesticide residue risk associated with substituting conventionally grown products by organically grown ones, reflecting an increased health benefit (Saba and Messina 2003).

Local Foods

The term "local food", "local food system" or "short food supply chain" compasses different dimensions. It is a geographical distance between food producers and consumers. It is also a political-social concept, in the sense that it represents a

counter movement to the dominant trend toward larger scale, industrial-like farm operations, considering the modern food system (Peters et al. 2008). According to this argument, local food systems are also related to small farms that are linked to the community through social and economic relationships, in the sense to bring farmers and consumers together (Hughes et al. 2007). This enables consumers to connect with the place of production, people involved and methods of production used, providing increasing public awareness, knowledge and understanding of issues related to how foods are produced and signals related to the origin of the food product (Lapping 2004). The link between the food product and a geographic area or region of origin has been an increased interest in Europe essentially by the increasing policy support, particularly within the EU, and the fact that European consumers look for products that are authentic (Ribeiro et al. 2016).

Consumers buy local food products at farmers' markets or places that are physically proximate to the farmer, as they are perceived to have a higher quality (because they are fresher) and less processed, to be more healthy and nutritious (because of shorter travel distances), to have a better taste (reinforcing their perceived natural content and authenticity), to support the vitality of rural areas by providing an ever-growing multiplier effect within the local economy; and to have an environmental friendly production process (Lee and Kader 2005; Selfa and Qazi 2005; Zepeda and Le 2006).

In fact, one of the potential social benefits of local food systems arises from transportation cost savings. Local food can serve as a substitute for food shipped from often distant countries or regions, therefore reducing "food miles". The reduction of food travel distance allows the reduction of fossil fuel energy use, accompanied with declines in greenhouse emissions such as CO_2, and environmental pollution (Pirog and Rasmussen 2008). Nevertheless, other factors affect the impact of transportation on greenhouse emissions, rather than transport distance, such as the mode of transport or the type of transport (cooled or uncooled). For example, CO_2 emissions are slightly higher for fruits and vegetables transported using air freight, whereas fruits and vegetables traveled by sea have a lower emissions ratios, even for long-distance travel, because this is a highly energy-efficient method of moving goods (Saunders and Hayes 2007). Moreover, other contributions to energy use and emissions, other than transportation, may be important to assess the overall impact of local food systems (farm inputs, farm production, processing, distribution, consumption and disposal). In this context, provenance and the mode of agriculture production assumes particular relevance. When using the total life cycle of GHG emissions for different vegetable supply chains, higher emissions in food transport (long-distance travel) coupled with low emissions in food production (open field) may in some cases net lower GHG mission when compared to lower emissions in food transport (locally grown) coupled with higher emissions in production, due to temperature-controlled greenhouse using fossil fuels, particularly for cold countries, as greenhouses in colder climates need to be heated (Chen et al. 2016).

Food Waste Concern

According to the FAO, one-third of all edible food produced for human consumption is wasted or otherwise lost from the food chain per year, or about 1.3 billion tonnes (Gustavsson et al. 2011). The food wastage is particularly severe in industrialized countries: following the FAO's food balance sheet for 2007, food waste in North America and Europe is about 95–115 kg/capita/year, whereas in South/Southeast Asia and Sub-Saharan Africa it is 6–11 kg/capita/year (Gustavsson et al. 2011).

Furthermore, rising population levels combined with shifting dietary patterns in emerging economies will put increasing pressure on the global food supply, as more food is necessary to feed more people. The United Nations predicts that the world population will reach 9.6 billion by 2050 (UN 2012) and this growth will require at least a 70% increase in food production, excluding crops used for biofuels (FAO 2009) or a more efficient use of natural resources and food production (EC 2014). In this context, food waste generation is particularly an ethical issue. Wasting food means missing opportunities to feed the growing world population (FAO 2012a), and the consumption of scarce resources (like land, water and energy) used in the production, processing, distribution and the consumption of food (Bräutigam et al. 2014). In turn, this, leads to diminished natural ecosystems and the services that they provide (Hall et al. 2009).

Although food waste occurs along a food supply chain in both developed and developing countries (Parfitt et al. 2010), different strategies are needed to tackle food waste in these countries (Gustavsson et al. 2011). In developing countries, food waste arose mostly during the early and middle stages of the food chain (production, harvest, processing, storage and transportation stages), due to lack of infrastructure within the food chain, and lack of knowledge or investment in technologies (FAO 2012b). By contrast, in developed countries, food is to a significant extent wasted in both retail and consumption stages, both in households and food services (Monier et al. 2010). For example, considering the whole food supply chain, with the exception of agricultural production, the generation of food waste across the EU-27, based on the EUROSTAT database, in 2006, accounted for 89 million tonnes, corresponding to 181 kg/capita (Monier et al. 2010). The consumption stages (household activities and food and beverage service sector) generated 56% of all the food waste produced by food value-adding chain, with a higher proportion of avoidable food waste. This approach is particularly important when taking into account the increasing consumption of food away from home in the last decades in Western countries, due to modern lifestyles and time (Moura and Cunha 2005). Different factors may explain the avoidable food waste (edible food by the majority of people). At home, with too much food being cooked, prepared, served or damaged during this processing, and the expiration date label (Quested and Johnson 2009). In food services, consumers' distaste for given menu items, and overproduction due to inaccurate forecasting of consumers demand (Oliveira et al. 2016).

The significant quantity of food waste generates substantial amounts of GHG emissions, promoting climate change. Methane (CH_4) is produced when food waste decomposes under anaerobic conditions in food waste landfills (Buzby and Hyman 2012). Even though, there are clear indications of a shift away from landfilling towards preferred waste management approaches in the EU, 50% of biodegradable waste or bio-waste generated in the EU-27 in 2010, was still landfilled (EEA 2013). Food waste generated within the EU-27 during 2006, generated GHG emissions equivalent to 170 million tonnes of CO_2, considering the full life cycle of food, from the agricultural sector to the final consumer. Due to increasing quantities of food waste, emissions estimates for 2020 rise to about 240 million tonnes of CO_2 equivalent gases being released (Monier et al. 2010). That baseline value represents approximately 3% of total EU-27 emissions in 2008 and is close to the total GHG emissions of Romania or of the Netherlands in 2008.

Food, Sustainability and Education: The e-Learning Food Consumption and Environment Module Approach

Food consumption is one of the private consumption areas that has the largest impact on the environment, as one third of households' total environmental impact, including energy and land use, water and soil pollution and GHG emissions, is related to food and drink consumption (EEA 2005).

In this context, education for sustainability plays a particular role in achieving more sustainable food consumption patterns as students acquire these skills and apply to their daily lives (Luppi 2011).

With many advances in information and communication technologies there have been tremendous impacts on the format and on the approach to teaching and learning, most notably in terms of online education programs (Hay et al. 2004). Online education provides students an alternative method of study facing individuals' busy lifestyle, allowing students to be able to proceed at their own pace and identify their own personal course timeline (Shanley et al. 2004). E-learning offers a great number of opportunities of interaction and decision-making, based on flexibility of format and easy access to knowledge, as well as engagement within the learning process (Aires et al. 2014).

For the academic year of 2010/2011, the Food Consumption and Environment module took place in the context of e-learning as in M.Sc. in Participation and Environmental Citizenship course offered by Universidade Aberta (UAb), the only public distance learning higher education institution in Portugal in the area of online and advanced e-learning (Azeiteiro et al. 2015). It was a formal course, organized according to the European Credit Transfer and Accumulation System (ECTS), and with the virtual pedagogical model of UAb (Pereira et al. 2007). In this context, the forum was used to allow for asynchronous exchanges: teacher guidelines, questions

posed by students and discussion. The open source Moodle (http://elearning.uab.pt/) was the course platform solution used in all UAb's courses.

The module was taught completely in e-learning mode and was organised in a set of topics, each of them developed in a two to four week period. Generally, each topic was associated to one learning task. The teaching and learning method used engages the student in active learning of concrete and critical problems that are real. This is achieved through the inclusion of a number of activities with accompanying teacher such as: surveys, quizzes, assignments compulsory discussion groups and searching on the internet to access online databases (Moura et al. 2010). Support materials included the teacher's slide presentations and original documents, scientific papers, research papers and internet websites. The continuous assessment component (obtained through the e-activities) is weighted at a minimum of 60% of the entire module evaluation.

The Food Consumption and Environment programme intents to cover the environment "hot spots", according to the academic literature review presented previously, covering the following topics:

- *The complexity of* "*global food system*". Its approach was to emphasise the diversity of actors and their interactions along the food chain and the markets where the product is exchanged.
- *The perception of food safety*. In this case, fears about a given food create adversely short-effects on preferences and consumption of that particular food.
- *The individual food choice criteria*. The main food choice determinants were identified which range in scope from sensory and psychological preferences to practical reasons (convenience, price, variety) and personal concerns (wellbeing, self-expression, sustainability) (Moura and Cunha 2005).
- *Sustainable food consumption*: *drivers and barriers*. The major environmental impacts of food consumption were considered: waste generation, recycling, personal transport, residential energy use for preserving and preparing food, and food preferences.
- *The new food choice and consumer paradigms*. Students were asked to contrast one sustainable food product (organic foods and traditional food products) and one unsustainable food product perceived by consumers (genetic modified foods). This was a work team activity.

Activity Theory: A Framework for Online Learning

The aim of this study was to explore how well students responded to the task proposed by the teacher to achieve its outcome, which resulted from students dynamics of online communication during the group work forum. For this, the *subject* (the students) was motivated by the need to transform an *object* (a problem

or idea) into its desired *outcome* (a reflection report about a real food safety incident from a press release), by carrying out a series of actions that are mediated by *tools.* This approach has a framework called the activity theory (AT). The application of the AT for better understanding the social structure of online environments follows Engeström (1999) and Baran and Cagiltay (2010) approach. Within AT, the student is not analysed separately but rather in a social context while interacting with other students and the teacher. AT was initially developed by Leontiev. Its original framework it was founded in the Vygotkian concept of mediation, mainly in the triangle: subject, object and tool (Fig. 1). Engeström (1999) later advocates new AT generations. In the second AT generation the author argues that the focus of mediation is the relationship of the expanded basic Vygotsky triangle and the relationships of other components of the activity system - communities, rules, and division of labour, a model to represent the human system activity (Fig. 1). Later Engeström (1999) expands the third AT generation with dialogue.

The different items of the triangular model applied to the topic "perception of food safety" are presented subsequently in order to better understand the relationships between each item to mediate the interactions (Fig. 1).

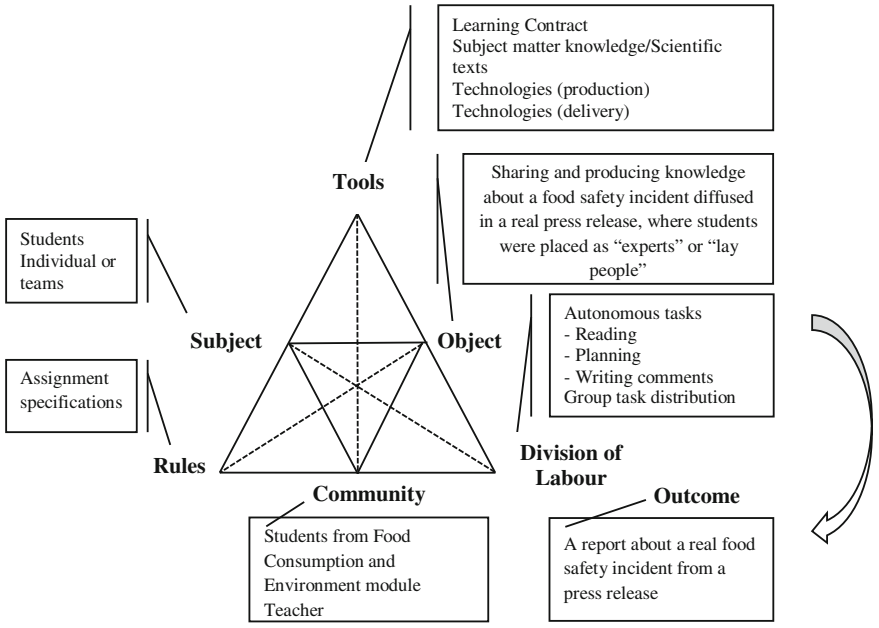

Fig. 1 Designing a topic of e-learning activity system. *Source* Adapted from Baran and Cagiltay (2010), Blin and Munro (2008)

Items of the Triangular Model

Subject

In 2010/2011, a student group of 12 students (58% men), average age of 47.7 ± 8.5 years, from Portugal and from Portuguese-speaking African countries (Mozambique and Cape Verde) were enrolled in this module with a diverse academic background, coming from disciplines such as engineering, environmental sciences, humanities (geography), life sciences (nursing) or social sciences (Table 1).

Object

The purpose of this task was to develop and assess students' perceptions of food safety incidents, considering the role of different agents of the food chain: the food company, the Portuguese food regulator and the consumer. In this case, fears about a given food create adversely short-effects on preferences and consumption of that particular food, and it would be interesting to confirm if there is some similitude of individual students' behaviour regarding a proxy food crisis situation.

The task proposed to students was from a real press release developed in July 2007. The news article communicated that some lots of a dairy product from a leader brand, target to children, were removed from the market because there was a probability that one of his additive (the guar gum) could be contaminated with two substances: dioxins and pentachlorophenol. It also communicated on the news article that the national regulatory authority did not assign an imminent risk to the consumers' health, since the amount of additive present in the food in question was

Table 1 Characteristics of the students

Student code	Gender	Age (years)	Academic degrees (Higher Diploma)	Residential area
P1	Male	47	Sociology	Cape Verde
P2	Female	39	Environmental Health	Central region of Portugal
P3	Male	43	Safety Engineering	Central region of Portugal
P4	Female	55	Physics and Chemistry	Central region of Portugal
P5	Male	51	Nursing	Central region of Portugal
P6	Female	33	Public Relations	Azores (Island, Portugal)
P7	Female	53	Geography	Central region of Portugal
P8	Male	42	Social Sciences	Mozambique
P9	Male	42	Social Sciences	Central region of Portugal
P10	Female	43	International Relations	Central region of Portugal
P11	Female	37	Biochemistry	Azores (Island, Portugal)
P12	Female	63	Physics and Chemistry	Southern region of Portugal

low (residual presence). This task comprised two parts. Firstly, students worked in a team for a period of eight days, when they were asked to evaluate the press release placing as "experts" or as "lay people", according to the position given by the teacher. At the end, each group submitted their work in the platform.

Tools

Support materials included teacher's slide presentations and original teacher's documents, scientific publications (papers, research papers), website links, and digital video created by the teacher and produced by the UAb digital services related specifically to perception of food risk. The technologies available to produce materials included computers, generic applications such as MS Word, and the technologies to deliver them included forum posts, Moodle technologies and functionalities.

Rules and division of labour

In accordance with the virtual pedagogical model of UAb for the MSc courses, the Food Consumption and Environment module is a structuring element, the Learning Contract that acts as a mediator between the academic requirements and the students' needs and interests (Pereira et al. 2007). This document, presented to students since the beginning of the module, is structured into module objectives, topics/tasks to be developed (that are chronologically presented), competences to be acquired or developed, list of support learning materials and module assessment. In this context, the Learning Contract acts as a pedagogical tool that incorporates the *object*, *rules* and *tools*.

Additionally, students should considered at least three main rules defined by the teacher: (i) to interact with the other group members for the report construction; (ii) to deliver the report on time; (iii) to accomplish the number of pages imposed by the teacher.

Moreover, the team work forums were separated forums composed by two to four members and supported work in smaller groups, where members discussed the subject in private in order to elaborate their work. Students worked through notes and/or power point presentations prepared by their teacher, commented information transmitted by their colleagues via the group work forum, and understood the subject matter by helping to produce the report group.

Community

This community consist of the 12 students who participated in the Food Consumption and Environment module. They were from different academic backgrounds and place of residence.

Sub-activity System Analysis

The activity system was broken down into the following four sub-activity trials: (i) subject-tools-object; (ii) subject-division of labour-object; (iii) subject-community-object; and (iv) subject-rules-object. For this, we analyzed parts of the discussion posts exchanged by students during the group work, presenting for each sub-activity trial only one discussion from either of the four groups. The quotes used in this text were translated into English, where the brand in question was referred to as "brand XX" and the company as "food company YY". The students will be identified with a code.

Subject-Tools-Object

During the knowledge creation process, students looked at the same problem from different points of view, as students of this module came from a wide range of backgrounds, nationalities and cultures (Table 1).

The news article to be analyzed, the scientific publications, the digital video and the documents made by the teacher allowed students to better understand the subject. Moreover, the task proposed and the fact that students evaluated the press release placing as "experts" or as "lay people", brings the subject to life and provides them with opportunities to link theory to practice in order to better acquire the perception of food safety and its consequences to the food chain.

> **Group work 3**
>
> **by P10—Tuesday, 2nd November 2010, 23:58**
>
> Dear colleagues,
>
> Given that we have to write a report in the point of view of a "specialist", I have done a brief research about the matter that I have referred and I would like to share the collection of information with you.
>
> Maybe some of this information can be put into our document.
>
> I confess, that with everything I have read and heard, it is increasingly difficult to choose what to eat and what I give to eat, especially to my children.
>
> It is difficult to run away from this involuntary ingestion of toxic materials, as we don't even have the notion of what happens in the production circuit until it reaches us consumers… I think that all of this is scary and you just need to see the kind of diseases that grow from what we eat.
>
> But as "specialists" we have the duty to alert, don't we?

by P6—Thursday, 4th November 2010, 13:50

Hi P10,

I've already read the teacher's documents and the notes that you left of your research.

When I read the news article for the 1st time, what I immediately considered as fundamental was to understand what really is the guar gum and the pentachlorophenol in a way to figure out the dimension of the eventual problem.

Like that, during the course of today, I will research on the mutter.

Additionally, the group work forum served as an essential tool. The asynchronous exchange of knowledge across students, reinforcing a holistic approach to education where analytic skills, cross-referencing and critical thinking facilitated a critical conversation (Altomonte et al. 2016). The discussion supported dialogue between students, so that comments, information, data and links were shared. A total of 91 posts were sent to the discussion during the group work forum (Table 2).

Subject-Rules-Object

The rules announced previously were accepted and adopted by students, as they defined the process of reaching their objectives. Moreover, students were aware that the teacher could access the group work forum and follow the discussion. This may condition their participation, as their performance affects their grades. Additionally, for Master's degree students, the virtual pedagogical model of UAb achieves to promote a strong interaction and collaboration between students and teachers and recognises students as active builders of this interaction (Pereira et al. 2007).

Group work 2

by P5—Wednesday, 3rd November 2010, 22:21

Hi colleagues,

It is the first time that we will all work together. I don't know how you are, but I have been absent for a couple of days and I'm now seeing that I have a lot of work to do.

Table 2 Characteristics of the group work forum

Characteristics	Group 1	Group 2	Group 3	Group 4
Number of members	3	4	2	3
Members (code)	P1, P4, P11	P5, P7, P8, P12	P6, P10	P2, P3, P9
Number of posts exchanged	8	21	29	33

I don't know your opinion, but we could schedule some deadlines for the completion of the work.

For example, we could schedule for until the 6th to read the texts and place our analysis of those texts by the 7th or 8th. In that way, we would have the 9th and 10th to elaborate our reports.

What is your opinion?

Good work.

by P5—Wednesday, 10th November 2010, 12:45

Hello P12,

I think that for a "start" it will be good. However, it has been asked of us that we produce a work between 4 and 6 A4 pages.

I have already placed a proposal to be discussed and so has Manuel. I would like if you gave your opinion (and the other colleagues too) to see if we can put the work together with all contributions.

Subject-Division of Labour-Object

Generally, for the four groups, two moments were identified when students analysed the real article that considered dairy products targeted to children that were potentially contaminated with two substances. In the first moment, students intended to identify the structure of the report, by highlighting the main topics to consider in the report. Once this step was stabilized, an attempt of division of labour emerged as there was a schedule to accomplish.

Group work 4

by P3—Monday, 8th November 2010, 21:15

I have read the manual and taken some conclusions. How are we going to elaborate the work? Do we shoe all of our conclusions and someone compiles then or do we do it in parts? We have to put in our report until the 10th.

by P9—Tuesday, 9th November 2010, 09:15

I think that the nest way would be to place our conclusions and notes on the forum and then someone "compiles" them.

by P2—Tuesday, 9th November 2010, 16:54

P9, the document that you annexed could serve as an introduction, but the references are missing… could you place in the sources?

So the work will have an introduction, after that we will have to do the analysis of the news article, from the consumer point if view… what type of consumer should we be?
And should we talk in a more technical or simple manner?

Subsequently, students discussed and shared materials in order to produce and improve their group work, joining their own experience with these comments as process of a combination and socialisation. They commented on topics, criticised others' comments and sent their contributions, making their knowledge more explicit.

Group work 4 (cont.)

by P2—Sunday, 7th November 2010, 00:20

A news article of this sort can have, in y opinion, three answers from the consumers:
– trust in the brand: "so if they identity the problem and take the affected batches, it is because they possess a quality control. Maybe other brands have identical levels and they don't know (or don't say it)".
– skepticism of the product/brand: "if products for children have these contaminants, I can only imagine the rest of the products".
– neutrality: the point of view of someone that thinks that nowadays, everything is wrong (or on the contrary, that in the past there weren't so many precautions as today, and children would grow well). To this consumer, there might be a reduction in the purchase of the product, but something very slight and temporary (after all, the son actually likes so much these yogurts).
I don't know if we should explore all the possible consumer vies points in our work, or if we should choose the must consensual and approach the theme of that point of view…

by P9—Tuesday, 9th November 2010, 22:25

I don't think that the consumer was at all weakened by the matter of the "brand XX", once it was the "food company YY", that informed the authorities and removed the product from the market.

by P3—Wednesday, 10th November 2010, 18:48

If I were in the shoes of the consumer, I would be in doubt about the news article and would probably stop consuming the product and try to find alternatives from other brands that inspire confidence. Here we can see the situation of the power of "decision" that is very important, but I understand and agree with P9's conclusion. Therefore, there are different possible reactions from the consumer.

by P9—Wednesday, 10th November 2010, 18:55

I disagree with the choice of the two options, of considering the studies that were done but also consider that there wasn't a decrease in "food company YY" sales and the consumer will continue to buy the "brand XX" (I say this because I buy it!!)

by P2—Wednesday, 10th November 2010, 22:21th

P9, I don't know if at the time that decrease in sales wouldn't have existed… even if temporary…I personally don't buy, it is a very synthetic food filled with food colourings and sugars (but if you offer my daughter one I will let her have it, I'm not that fundamentalist!)

Analysing the dynamics of the division of labour for the four groups, all members contributed for the report construction. Additionally, we identify for some groups, a salient tension during de report construction as different approaches were considered when students analysed the consumer perception regarding the food crisis announced in the news article. Nevertheless, these dualities allowed for a learning progress considering that different perspectives were put in question (Barab et al. 2002). For example, considering the group 4's progress, the report submitted contemplated two hypotheses accommodating the different students' perspectives (P2 and P3 "against" P9): (i) consumers care about the food safety incidence and they lack confidence regarding the brand in question; (ii) consumers trust the institutions and the brand, as regulatory authorities did not take unplanned actions in response to the alert received.

Subject-Community-Object

Community members were students and the teacher from the Food Consumption and Environment module. Even if these students did not search social relations, patterns of interaction or an alternative source of knowledge, at the end they may participated in the task because they wanted to complete the module and obtain a Master degree. In this sense, students within the group work forum defined together the work plan and divided consensually the tasks in order to accomplish the report, however, a sense of community among them never completed formed.

Group work 1

by P4—Tuesday, 9th November 2010, 13:11

I don't think that we are working well as a group. The deadline for the work is tomorrow and there haven't been any exchange of ideas.
I am creating a summary of the concepts that in the meantime I will place on the forum, but I would like to know what the group intends to do and in which way should the report be done.
I await for your exchange of ideas.

by P11—Tuesday, 9th November 2010, 13:24

Hello P4,
I have just placed some concepts and regulations that I think could be useful for our work, I don't know if you have already seen them?

In my opinion, referring to the way in which we should create the report, we could do it in the following way:

Introduction
– food safety and its evolution in its last few years.
– the different concerns of consumers and specialists.
– talk about the new article itself.

Middle
– describe the dangers of the substances to consumers.
I cannot remind myself of anything more for the moment, I don't know, what do you think?

by P4—Wednesday, 10th November 2010, 14:25

I hope that the work stands up to the challenge that has been proposed to us. Can you P11 place the work on the forum?

by P11—Wednesday, 10th November 2010, 15:11

Yes, I agree with you, I'm going them to place our work on the forum with our student number.
I also hope that it meets the demands of the proposal.
See you soon.

Discussion

The relevance of the "food dimension" for sustainability policies is now widely accepted. As a result, consumers have a major role in making food chains more sustainable, by the choices they make when buying food. Consumers can reward more sustainable food production and punish less sustainable alternatives (Grunert 2011).

The Food Consumption and Environment module, delivered entirely online, may offer an opportunity to a better understanding of the major perceived influences on individual food choice and their impact on the environment, as it covers the contemporary environmental problems related to food. The Activity Theory (AT) fostered the design of an analysis model in this topic, as it describes complex interactions and learning relations. Therefore, AT appears as a relevant framework to analyse the online learning process. For this, instead of simply transmitting factual information about sustainability concepts and processes, the module's approach was twofold: to use experiential and interactive learning processes (a learner-centred approach), and to encourage the adoption of sustainability principles, ethics and values (a transformative approach), supporting the critical reflection of them (Barth and Burandt 2013). In this context, the asynchronous discussion forums, namely the group work forums, supported this learning process offering the

opportunity to deeply reflect on the topic of food consumption sustainability and gather relevant information before contributing to the discussion on the subject. Although this tool allows for sociability among the students community across long distances, a robust relationship was not formed as these members were together only to accomplish specific objectives (Baran and Cagiltay 2010). To overcome this situation, Blin and Munro (2008) proposed the use of other communication tools that demand collaboration or reflection, such as glossaries, journals, and wikis. Nevertheless, the tasks and the module were limited on time and this short time period restricted pedagogic relationships that would sustain additional live and class experience. Other informal settings, namely social networking websites (e.g. Facebook) are more oriented to increase social presence of individual members of a community (Aires et al. 2014).

References

Aires, L., Dias, P., Azevedo, J., Rebollo, M. A., García-Perez, R. (2014). Education, digital inclusion and sustainable online communities. In: U.M. Azeietiro, W. Leal Filho, S. Caeiro (Eds.), *E-learning and education for sustainability* (pp. 263–273), Frankfurt: Peter Lang. doi:10.3726/978-3-653-02460-9.

Altomonte, S., Logan, B., Feisst, M., Rutherford, P., & Wilson, R. (2016). Interactive and situated learning in education for sustainability. *International Journal of Sustainability in Higher Education, 17*(3), 417–443. doi:10.1108/IJSHE-01-2015-0003.

Azeiteiro, U. M., Bacelar-Nicolau, P., Ceatano, F. J. P., & Caeiro, S. (2015). Education for sustainable development through e-learning in higher education: experiences from Portugal. *Journal of Cleaner Production, 106,* 308–319. doi:10.1016/j.jclepro.2014.11.056.

Barab, S. A., Barnett, M., & Squire, K. (2002). Developing an empirical account of a community of practice: Characterizing the essential tensions. *The Journal of the Learning Sciences, 11*(4), 489–542. doi:10.1207/S15327809JLS1104_3.

Baran, B., & Cagiltay, K. (2010). The dynamics of online communities in the activity theory framework. *Journal of Educational Technology & Society, 13*(4), 155–166.

Barth, M., & Burandt, S. (2013). Adding the "e-" to learning for sustainable development: Challenges and innovation. *Sustainability, 5,* 2609–2622. doi:10.3390/su5062609.

Blin, F., & Munro, M. (2008). Why hasn't technology disrupted academics' teaching practices? Understanding resistance to change through the lens of activity theory. *Computers & Education, 50*(2), 475–490. doi:10.1016/j.compedu.2007.09.017.

Bräutigam, K. R., Jörissen, J., & Priefer, C. (2014). The extent of food waste generation across EU-27: Different calculation methods and the reliability of their results. *Waste Management & Research, 32*(8), 683–694. doi:10.1177/0734242X14545374.

Buzby, J. C., & Hyman, J. (2012). Total and per capita value of food loss in the United States. *Food Policy, 37*(5), 561–570. doi:10.1016/j.foodpol.2012.06.002.

Chen, D. M., Tucker, B., Badami, M. G., Ramankutty, N., & Rhemtulla, J. M. (2016). A multi-dimensional metric for facilitating sustainable food choices in campus cafeterias. *Journal of Cleaner Production, 135,* 1351–1362. doi:10.1016/j.jclepro.2016.06.143.

Cordain, L., Eaton, S. B., & Sebastian, A. (2005). Origins and evolution of the Western diet: Health implications for the 21st century. *American Journal of Clinical Nutrition, 81*(2), 341–354.

Cunha, L. M., Moura, A. P. (2004). Conflicting demands of agricultural production and environment protection: consumers' perception on quality and safety of food. In W. L. Filho (Ed.), *Ecological agriculture and food production in Central and Eastern Europe-risks associated with*

industrial agriculture (pp. 137–157). NATO Scientific Series. Berlin: IOS Press. ISSN: 1387-6708.

Cunha, L. M., Moura, A. P., Lopes, Z., Santos, M. C., Silva, I. (2010). Public perceptions of food-related hazards: an application to Portuguese consumers. *British Food Journal, 112*(5), 522–543. doi:10.1108/00070701011043772.

Davis, J., Sonesson, U., Baumgartner, D. U., & Nemecek, T. (2010). Environmental impact of four meals with different protein sources: case studies in Spain and Sweden. *Food Research International, 43,* 1874–1884. doi:10.1016/j.foodres.2009.08.017.

Drewnowski, A., & Popkin, B. M. (1997). The nutrition transition: New trends in the global diet. *Nutrition Reviews, 55*(2), 31–43.

EC. (2007). Council regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing regulation (EEC) No 2092/91. *Official Journal of the European Communities, L 189*(1), 1–23.

EC. (2014). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions—towards a circular economy: A zero waste programme for Europe, Brussels.

EEA. (2005). Household consumption and the environment. Report No. 11, Copenhagen.

EEA. (2013). Managing municipal solid waste—A review of achievements in 32 European countries. EE Report No 2/2013, Copenhagen.

Engeström, Y. (1999). Activity theory and transformation. In Y. Engeström, R. Miettinen, R. L. Punamäki (Eds.), *Perspectives on activity theory* (pp. 19–38). Cambridge: Cambridge University Press. ISBN-13: 9780521431279, ISBN-10: 0521431271.

FAO. (1998). Evaluating the potential contribution of organic agriculture to sustainability goals. In *FAO's technical contribution to IFOMS Scientific Conference.* Mar del Plata, Argentina, 16–19 Nov 1998.

FAO. (2006). *Livestock's long shadow: Environmental issues and options*. Rome: FAO.

FAO. (2009). *How to feed the world in 2050*. Rome: FAO.

FAO. (2012a). Sustainable diets and biodiversity. Directions and solutions for policy, research and action. In *Proceedings of the international scientific symposium: Biodiversity and sustainable diets against hunger.* Rome: FAO, 3–5 Nov 2010.

FAO. (2012b). *The role of producer organizations in reducing food loss and waste*. Rome: FAO.

Friel, S., Dangour, A. D., Garnett, T., Lock, K., Chalabi, Z., Roberts, I., et al. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. *Lancet, 374* (9706), 2016–2025. doi:10.1016/S0140-6736(09)61753-0.

Grunert, K. G. (2011). Sustainability in the food sector: A consumer behavior perspective. *International Journal on Food System Dynamics, 2*(3), 207–218.

Gustavsson, J., Cederberg, C., & Sonesson, U. (2011). *Global food losses and food waste extent, causes and prevention*. Rome: FAO.

Hall, H. D., Guo, J., Dore, M., & Chow, C. C. (2009). The progressive increase of food waste in America and its environmental impact. *PLoS ONE, 4,* e7940. doi:10.1371/journal.pone.0007940.

Hay, A., Peltier, J., & Drago, W. (2004). Reflective learning and on-line education: A comparison of traditional and on line MBA students. *Strategic Change, 13*(4), 169–182. doi:10.1002/jsc.680.

Hughes, D. W., Eades, D., Robinson, K., Carpio, C., Isengildina, O., Brown, C. (2007). What is the deal with local food systems: or, local food systems from a regional science perspective. WP 11-2007-01, USA: Clemson University.

IFOAM. (2008). *Principles of organic agriculture: Preamble*. Germany: IFOAM.

Kasperson, J. X., Kasperson, R. E., Piedgeon, N., Slovic, P. (2003). The social amplification of risk: assessing fifteen years of research and theory. In N. Pidgeon, R. E. Kasperson, P. Slovic (Eds.), *The social amplification of risk* (pp. 13–46). Cambridge: Cambridge University Press. ISBN: 9780521520447.

Kearney, J. (2010). Food consumption trends and drivers. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 365*(1554), 2793–2807. doi:10.1098/rstb.2010.0149.

Lapping, M. B. (2004). Toward the recovery of the local in the globalizing food system: The role of alternative agricultural and food models in the US. *Ethics, Place and Environment, 7*(3), 141–150. doi:10.1080/1366879042000332943.

Lee, S. K., & Kader, A. A. (2005). Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest Biology and Technology, 20*(3), 207–220. doi:10.1016/S0925-5214(00)00133-2.

Loo, E. J. V., Hoefkens, C., & Verbeke, W. (2017). Healthy, sustainable and plant-based eating: Perceived (mis)match and involvement-based consumer segments as targets for future policy. *Food Policy, 69,* 46–57. doi:10.1016/j.foodpol.2017.03.001.

Luppi, E. (2011). Training to education for sustainable development through e-learning. *Procedia-Social and Behavioral Sciences, 15,* 3244–3251. doi:10.1016/j.sbspro.2011.04.279.

Magnusson, M. K., Arvola, A., Hursti, U., Aberg, L., & Sjoden, P. (2003). Choice of organic foods is related to perceived consequences for human health and the environmentally friendly behavior. *Appetite, 40*(2), 109–117. doi:10.1016/S0195-6663(03)00002-3.

Mil-Homens, A. S., Moura, A. P., Cunha, L. M. (2016). Food regulations and enforcement in Portugal. *Reference Module in Food Sciences,* 1–7. http://dx.doi.org/10.1016/B978-0-08-100596-5.21099-8.

Monier, V., Shailendra, M., Escalon, V., O'Connor, C., Gibon, T., Anderson, G., Hortense, M., Reisinger, H. (2010). Preparatory study on food waste across EU 27. European Commission (DG ENV) Directorate C-Industry, Final Report.

Morinaka, T., Wozniewicz, M., Jeszka, J., Bajerska, J., Nowaczyk, P., & Sone, Y. (2013). Westernization of dietary patterns among young Japanese and Polish females—A comparison study. *Annals of Agricultural and Environmental Medicine, 20*(1), 122–130.

Moura, A. P., & Cunha, L. M. (2005). Why consumers eat what they do: An approach to improve promoting new responses. In D. Doyle (Ed.), *Consumer citizenship: Promoting new responses* (pp. 144–156). Harmar: Forfatterne. ISBN 82-7671-498-6.

Moura, A. P., & Cunha, L. M. (2009). Understanding the role of printed media in the social amplification of food risk during the new millennium. In A. Klein & W. Thoresen (Eds.), *Consumer citizenship: Promoting new responses, making a difference* (pp. 144–155). Norway: Fortatterne. ISBN 978-82-7671-754-9.

Moura, A. P., Cunha, L. M., Azeiteiro, U. M., Aires, L., Graça, P., & de Almeida, M. D. V. (2010). Food consumer science post graduate courses: Comparison of face to face versus online delivery systems. *British food Journal, 112*(5), 544–556. doi:10.1108/00070701011043781.

Murdoch, J., & Miele, M. (1999). "Back to nature": Changing 'worlds of production' in the food sector. *Sociol Rural, 39*(4), 465–483. doi:10.1111/1467-9523.00119.

Nemecek, T., Jungbluth, N., Canals, L. M., & Schenck, R. (2016). Environmental impacts of food consumption and nutrition: Where are we and what is next? *International Journal of Life Cycle Assessment, 21*(5), 607–620. doi:10.1007/s11367-016-1071-3.

Oliveira, B., Moura, A. P., Cunha, L. M. (2016). Reducing food waste in the food service sector as a way to promote public health and environmental sustainability. In: W.L. Filho, U.M. Azeiteiro, F.A. Alves (Eds.), *Climate Change and health improving resilience and reducing risks* (pp. 117–132). Switzerland: Springer. doi:10.1007/978-3-319-24660-4_8.

Pan, A., Sun, Q., & Bernstein, A. M. (2012). Red meat consumption and mortality. Results from 2 prospective cohort studies. *Archives of Internal Medicine, 172*(7), 555–563. doi:10.1001/archinternmed.2011.2287.

Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 365,* 3065–3081. doi:10.1098/rstb.2010.0126.

Pereira, A., Mendes, A. Q., Morgado, L., Amarante, L., & Bidarra, J. (2007). *Virtual pedagogical model: Model of Universidade Aberta for a future University*. Lisbon: Universidade Aberta (in Portuguese). ISBN 978-972-674-493-1.

Peters, C. J., Nelson, L. B., Wilkins, J. L., & Fick, G. W. (2008). Foodshed analysis and its relevance to sustainability. *Renewable Agriculture and Food Systems, 24,* 1–7. doi:10.1017/S1742170508002433.

Pirog, R., Rasmussen, R. (2008). Food, fuel and the future: consumer perceptions of local food, food safety and climate change in the context of rising prices. Leopold Center, Iowa State University, USA.

Popkin, B. M., & Du, S. (2003). Dynamics of the nutrition transition toward the animal foods sector in china and its implications: A worried perspective. *Journal of Nutrition, 133*(11 Suppl 2), 3898S–3906S.

Quested, T., & Johnson, H. (2009). *Household food and drink waste in the UK: A report containing quantification of the amount and types of household food and drink waste in the UK*. Banbury, UK: WRAP.

Ribeiro, A. L., Moura, A. P., Cunha, L. M. (2016). Consumer's valuation and quality perception of kid's meat from traditional "cabrito da Gralheira": Protected geographical indication. In: K. Kristbergsson, J. Oliveira (Eds.), *Traditional foods: General and consumer aspects* (pp. 17-30). New York: Springer. doi:10.1007/978-1-4899-7648-2_2.

Saba, A., & Messina, F. (2003). Attitudes towards organic foods and risk/benefit perception associated with pesticides. *Food Quality and Preference, 14*(8), 637–645. doi:10.1016/S0950-3293(02)00188-X.

Saunders, C., & Hayes, P. (2007). Air freight transport of fresh fruit and vegetables. Research Report No. 299, New Zealand: Lincoln University.

Selfa, T., & Qazi, J. (2005). Place, taste, or face-to-face? Understanding producer–consumer networks in "local" food systems in Washington State. *Agriculture and Human Values, 22,* 451–464. doi:10.1007/s10460-005-3401-0.

Shanley, E. L., Thompson, C. A., Leuchner, L. A., Zhao, Y. (2004). Distance education is as effective as traditional education when teaching food safety. *Food Service Technology, 4*(1), 1e8. doi:10.1111/j.1471-5740.2003.00071.x.

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., & de Haan, C. (2006). *Livestock's long shadow—Environmental issues and options*. Rome: FAO.

Thornton, P. K. (2010). Livestock production: Recent trends, future prospects. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 365,* 2853–2867. doi:10.1098/rstb.2010.0134.

Tuomisto, H. L., Hodge, I. D., Riordan, P., & Macdonald, D. W. (2012). Does organic farming reduce environmental impacts?—A meta-analysis of European research. *Environmental Management, 112,* 309–320. doi:10.1016/j.jenvman.2012.08.018.

UN. (2012). World population prospects, the 2012 revision. United Nations Department of Economic and Social Affairs, Population estimate and projections section, Rome.

Varela-Moreiras, G., Ávila, J. M., Cuadrado, C., del Pozo, S., Ruiz, E., & Moreiras, O. (2010). Evaluation of food consumption and dietary patterns in Spain by the food consumption survey: Updated information. *European Journal of Clinical Nutrition, 64,* S37–S43. doi:10.1038/ejcn.2010.208.

Westhoek, H., Lesschen, J. P., Rood, T., Wagner, S., De Marco, A., Murphy-Bokern, D., et al. (2014). Food choices, health and environment: effects of cutting Europe's meat and dairy intake. *Global Environmental Change, 26,* 196–205. doi:10.1016/j.gloenvcha.2014.02.004.

Willer, H., & Lernourd, J. (2017). The world of organic agriculture statistics and emerging trends 2017. Research Institute of Organic Agriculture (FiBL), IFOAM- Organics International, Bonn, Germany.

Zepeda, L., & Le, J. (2006). Who buys local food? *JFDR, 37*(3), 1–11.