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Raising Awareness of Sustainable Food Choices:

Development and Evaluation of a Game for Young Consumers

Master Thesis

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Motivation

"How to Feed the World While Considering Human Health" is the title of my bachelor thesis, by which I investigated the relation between environmental effects and food consumption. During my six months working for Presence Switzerland at the Swiss Pavilion, Expo 2015 I collected data throughout surveys about dietary patterns of people from all over the world. I subsequently quantified the environmental impact of those dietary patterns with the life cycle assessment (LCA). By using the same surveys, I also investigated the degree of knowledge about sustainable diet by asking the participants to rank six common food items from the one which has the lowest up to the highest ecological impact.

Thanks to my research I have understood that consumers lack awareness of what a sustainable diet is, as only a few know about the relationship between food consumption and its environmental impact.

With my desire to help preserve the resources of the planet, I have decided to contribute by spreading the message of sustainable diets.

With this goal in mind, I started looking for a project that shared my intentions and I ended up with the project: *"Forschung zum Aufassen. Hands-on learning for sustainability in agroecosystems",* an outreach program in collaboration with the World Food System Center and the Sustainable Agroecosystems Group. The program aims to help teenagers to better understand their role as consumers and food system actors. The overall project goal is to facilitate dialogue on research for sustainable food systems between teenagers, teachers, students and scientists as a contribution to Education for Sustainable Development.

My overall wish is to make young consumer more familiar with the relationship between climate change and food consumption paving the way to an environmentally-friendlier lifestyle and consequently change the food demand due to their role as actors in the economic system and even contribute to creating a healthier environment for us all.

During the first 3 days working on the project (organized by the Pro Juventute Ferienplausch), I realized that students are more willing to learn when they can actively experience the learning knowledge. Therefore, in order to achieve the goal of raising awareness of sustainable diets, I investigated what the methods are to learn in an enjoyable and fun way and I came up with gamification.

The method of my master project was thus the development of a game and in order to determine whether the game intervention is effective, the increase in knowledge and the the liking of the game were assessed.

Abstract

One of the possible strategies to mitigate global warming is through dietary patterns. The food system contributes to about 30% of the total GHG and 18% of that is due to Livestock. Hence there is a need to change dietary patterns toward more sustainable alternatives. Environmentally-friendlier diets are those with little GHG emissions and are identifiable with less consumption of meat and dairy products and are in favor of local, seasonal and organic food products. However, a substitution from meat to vegetables is not consistent with current trends. Raise awareness of sustainable food choices offer an opportunity to increase sustainable diet knowledge and might in the future to contribute to change dietary habits while providing environmental benefits. Young consumers are an interesting target group to raise awareness of sustainable food choices, since they start to have consumer experiences and learn consumer preferences, many of which will persist during the rest of their adult life. Gamification, which is defined as the use of game design elements in non-game contexts, was the method used for raising awareness. When gamification is applied to education, the opportunities for experiential, lifelong learning grows exponentially since learners are hooked by fun. Therefore, the aim of the project was to develop a game able to raise the awareness of sustainable food choices among young consumers. In order to assess the efficacy of the game intervention, the developed games were played in different classes. Subsequently the increase in knowledge of students and the liking of the game were assessed. The method used for the assessment was a quiz and the game itself was evaluated by means of a liking form. Descriptive statistics and SPSS Statistics, were used to analyse the results. The paired-sample t-test showed significant increase in knowledge. Therefore, Through the process of gamification, which consisted of the development of various prototypes based on the analysis of the context and the target group and the related evaluations, it was possible to obtain a prototype which is able to increase the knowledge of sustainable diets. In general, the design, the theme and the implementation of the game were liked.

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List of Abbreviations

CF	Carbon footprint
CO_2	Carbon dioxide
CO_2-eq	CO_2-equivalents
EF	Ecological footprint
FAO	Food and Agricultural Organization to the United Nations
GHG	Greenhouse gas
LCA	Life cycle assessment
LCI	Life cycle inventory analysis
LCIA	Life cycle impact assessment
CH_4	Methane
N_2O	Nitrous oxide
WF	Water footprint

1 Introduction

Food is a subject that every human being can identify with (Fisher, Erasmus, & Viljoen, 2016). After the Second World War, the Global food production has increased significantly due to a combination of expanding population and economic growth (Burlingame, 2013). The current world population of 7.3 billion is expected to reach 8.5 billion by 2030 and consequently the overall demand for food is expected to grow by 1.1% per year (UN, 2017; FAO, 2010).

Currently, the global food system is estimated to contribute to 30% of global greenhouse gas emissions (GHG) (IPCC, 2014). As agriculture is one of the direct drivers in the growth of GHG emissions, increasing the demand for food also means increasing global warming and therefore climate change. (Tukker, 2006).

Hence, the rising demand to transport, store, and consume the most resource-intensive food types (namely dairy and meat) will further increase the contributions of food and agriculture to environmental degradation (Keats, 2014). Indeed, eating habits changed considerably in the past fifty years, the overconsumption of meat, dairy and processed foods is not only harmful to human health but also has the greatest negative impact to the environment (Keats, 2014; Macdiarmid, 2011, 2012).

If what and how much we eat directly affects what and how much is produced, we therefore need to consume more “sustainable diets” (Johnston, 2014a).

1.1 Sustainable Diets

In recent years, a number of initiatives and studies focused more directly on the question of diets and their impacts on human health, the environment, and food systems. (Johnston, 2014a). In 2010, the FAO stated the following definition for sustainable diets: those diets with low environmental impacts that contribute to food and nutrition security and to healthy lives for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, are nutritionally adequate, safe, and healthy, and optimize natural and human resources (FAO, 2010).

What is actually meant by sustainability? Definitions of sustainability vary according to the stakeholders’ point of view (Garnett, 2014).

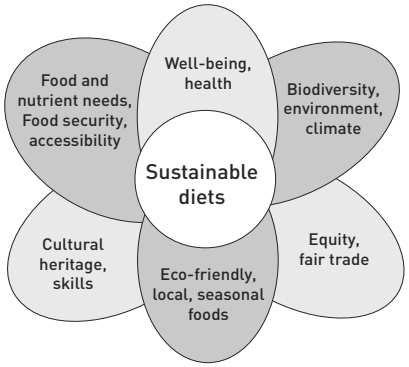

Fig. 1 Schematic representation of the key components of a sustainable diet (FAO, 2010)

Following the FAO definition, the word encompasses social, cultural, and economic dimensions, where environment, economy and society (incorporating health and ethics) together constitute the pillars of sustainability (Johnston, 2014a). While it is definitely hard to disagree with this definition, it is very unclear what such a sustainable diet might look like on the plate.

For the World Commission on Environment and Development sustainability is : "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987).

This statement links the global environmental deterioration with the rapid population growth, basically the environment's ability to generate human needs in the present and future (Langhelle, 2000).

In line with the last definition, the word sustainability was used more narrowly to refer to environmental impact and as synonym for just one environmental goal, such as GHG reduction (FAO, 2017). In fact, the atmosphere and oceans are warming, snow and ice cover is decreasing, and sea levels and GHG concentrations are increasing (IPCC, 2014). Each of the last three decades has been successively warmer than any previous decade since 1850, and if the same trend continues, the global average land temperature may increase by 3.7-4.8 °C in the course of the 21st century. To keep the temperature from rising more than 2 °C, GHG emissions must be reduced by 40 to 70% by 2050 relative to 2010 levels, then to zero by 2100 (Torquebieau, 2016).

1.2 Life Cycle Assessment and Carbon Footprint

A well-established method to analyse the environmental impacts of products is the Life cycle assessment (LCA). Indeed, when performing a LCA, all the resource depletion and the emissions which enter or leave a life cycle, which includes all processes that are related to the production, consumption and disposal phase (cradle to grave), are translated into the environmental problems (Jungbluth, 2011; Zbicinski, 2006).

The assessment can be split into four distinct steps: 1. goal and scope definition, 2. life cycle inventory analysis (LCI), 3. life cycle impact assessment (LCIA), and 4. life cycle interpretation (Caffrey, 2013). The inputs of resources, materials and energy as well as outputs of products and emissions are investigated and recorded in the LCI. Its result is a list of resources consumed and pollutants emitted. These elementary flows (emissions and resource consumptions) are described, characterised and aggregated during the LCIA. Conclusions are drawn during the "Interpretation" (ISO, 2006; Jungbluth, 2011).

Within this tool, a variety of different methods can be applied and the selection is subjective and based on its own relevance. Since the interest was in the relationship between food consumption and GHG emission, the Carbon Footprint (CF) was chosen.

Indeed, the CF is the calculation of the impact causing climate change, expressed in terms of carbon dioxide equivalent emissions (kg CO_2eq), associated with the production of a commodity throughout its entire life cycle (Jacobsen, 2014; BCFN, 2016).

The calculation is made considering the emissions of all greenhouse gases, principally carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), the amount of which is determined by two variables: the amount emitted and its impact factor in terms of Global Warming Potential (GWP). In effect CO_2, CH_4 and N_2O contribute differently to climate change, because they persist for a different length of time in the atmosphere and for the distinctive radiative force (IPCC, 2014).

Therefore, for characterising the impact, an equivalence factor: The Global Warming Potential, has to be applied. It converts the gases into CO_2-equivalents, based on how many times the gas contributes to the effect in comparison to the one of reference CO_2 (Zbicinski, 2006).

Table 1 Greenhouse gas transformation

Greenhouse Gas	***CO_2-equivalents***
CO_2	1
CH_4	25
N_2O	298

(IPCC, 2007)

1.3 Diets with Low GHG Emission

Another expression used to describe a diet with little environmental impact, so low GHG emission is environmentally-friendlier. Environmental-friendliness it is normally uses as a relative term, only in relation to other products and not as an absolute indicator. (Lazzarini, Zimmermann, Visschers, & Siegrist, 2016). Sustainable and environmentally-friendly are used as synonyms of little CF, while sustainable food choices is used as the practical application of the two terms. The food system contributes 19%–29% of total global anthropogenic GHG emissions (IPCC, 2014). Of this, agricultural production contributes 80%–86% while the remainder comes from preproduction (predominantly fertilizer manufacture) and the postproduction activities of processing, packaging, refrigeration, transport, retail, catering, domestic food management, and waste disposal (Vermeulen, 2012; Foley, 2011).

Consequently, a way to reduce the emissions of GHG is to focus on the agricultural stage. People who consume mostly organic food also eat less carbon intensive, since chemical pesticides and synthetic fertilizers are not used and the transportation via air is forbidden (Lindenthal, 2010; Schader, 2009; Treu, 2017; Venkat, 2012). However organic production only creates less GHG than conventional production for some food categories, as for instance fruits and vegetables (Meier, 2015; Nemecek, 2011; Treu, 2017) .

A reduction of GHG can be potentially achieved also by avoiding vegetables from heated greenhouses and sourcing them from Southern countries during winter and spring (Boulard, 2011; Hospido, 2009; Stoessel, 2012).

Even though transportation is not the biggest source of GHG, local foods are generally environmentally-friendlier due to their shorter transport distances (Rothwell, 2016; Roy, 2009; Schmitt, 2017; Sim, 2007; Weber, 2008).

1.4 Meat Matters

The estimated emissions attributable to livestock collectively are estimated at 18% (Steinfeld, 2006). Beef and cattle milk production account for the majority of emissions respectively contributing 41 and 20 percent of the sector's emissions, largely due to enteric fermentation (O'Mara, 2011).

From table 2 it easy to see that the production and consumption of animal based foods is associated with higher GHG emissions than plant based products.

Average global estimates suggest that, per unit of protein, GHG emissions from beef production are around 150 times those of soy products, by volume, and even the least emission-intensive meat products: pork and chicken, produce 20-25 times more GHGs than plant-based foods (Alvarez-Kalverkamp, 2014). It has been argued that a reduction in the amount of meat consumed in high and middle-income countries would have multiple benefits: a reduced demand for grain, leading to lower greenhouse gas emissions, and a positive effect on health (Foresight, 2011).

In a prospective cohort study, Biesbroek conclude that even though meat only contributed for 3.6% to the total weight of daily intake in grams of the studied diets, it is responsible for approximately 30% of dietary greenhouse gas emission and a 35 g/d reduction or shift from total meat intake to vegetables, fruit-nuts-seeds, pasta-rice-couscous would significantly reduce GHG emissions by about 4-12% (Biesbroek, 2014). Moreover, research suggests that reducing ''ruminant meat and dairy consumption will be indispensable'' for preventing global average surface temperatures from rising by more than 2-8 C° above preindustrial levels (Hedenus, 2014).

Dietary changes that substitute vegetable products for animal food may have a large mitigation potential (Berners-Lee, 2012).

Table 2 Average of GHG Emissions from Food Product

Food Types	***Carbon Footprint*** *(g CO_2-eq/g food)*	***References***
Bread	1	(Braschkat, Patyk, Quirin, & Reinhardt, 2003; Ag, 2016; Notarnicola, Tassielli, Renzulli, & Monforti, 2015)
Salad	1	(Clune, Crossin, & Verghese, 2017; Halberg, 2008; Hospido et al., 2009; Lindenthal et al., 2010; Stoessel et al., 2012; Tesco, 2012)
Tomatoes	1	(Boulard et al., 2011; Payen, Basset-Mens, & Perret, 2015; Tesco, 2012; Tobler et al., 2011b)
Cheese	14	(Clune et al., 2017; Jennie I Macdiarmid, Janet Kyle, Graham W Horgan, Jennifer Loe, Claire Fyfe, Alexandra Johnstone, 2012; Jungbluth, Keller, & Meili, 2017; Lindenthal et al., 2010; Nemecek et al., 2011; Notarnicola, Tassielli, Renzulli, Castellani, & Sala, 2017; Stoll-Kleemann & O'Riordan, 2015; Temme et al., 2013; Tesco, 2012)
Beef	27	(Clune et al., 2017; Eshel, Shepon, Makov, & Milo, 2014; Nijdam, Rood, & Westhoek, 2012; Nijdam et al., 2012; Notarnicola et al., 2017; Ray Jacobsen, Valerie Vandermeulen, 2014; Vainio, Niva, Jallinoja, & Latvala, 2016)
Pork	12	(Clune et al., 2017; Eshel et al., 2014; Nijdam et al., 2012, 2012; Notarnicola et al., 2017)
Chicken	7	(Clune et al., 2017; Eshel et al., 2014; Nijdam et al., 2012, 2012; Notarnicola et al., 2017)
Quorn	6.5	(Smetana, Mathys, Knoch, & Heinz, 2015; T J A Finnigan, 2010)
Soy	2.5	(Mejia et al., 2017; Smetana et al., 2015; Vainio et al., 2016)
Beans	2	(Sim et al., 2007; Tobler et al., 2011b; Vainio et al., 2016)
Salmon	12	(BC SALMON FARMERS ASSOCIATION, 2016; Clune et al., 2017; Nijdam et al., 2012, 2012; Pelletier et al, 2009; Scarborough et al., 2014; Weber & Matthews, 2008)

However, a substitution from meat to vegetables is not consistent with current trends (Hedenus, 2014). Consumption of meat continues to increase, worldwide meat production has tripled over the last four decades (OECD/FAO, 2017). According to the Swiss statistics office, the Swiss ate 51 kg per person per year, which is below the European average of 70 kg of meat per capita per year. But the Swiss consume more beef than those in the EU (14 kg vs. 10 kg) (FSO, 2017; Proviande, 2017). There is, thus, poor knowledge of the global mitigation potential through dietary changes under the controls of consumer preferences (Hedenus, 2014).

It has been recommended, that consumer awareness of the environmental costs of animal protein should be raised and that they need to be involved in realizing new ways to consume protein , in order to change their nutrition behaviour (Aiking, 2014; De Bakker, 2012). Nevertheless, consumers play a central role in enhancing sustainable diets, because consumer preferences both drive the demand for what type of food is produced and developed (Johnston, 2014b).

There is thus the need of implementing campaigns to change individual behaviour involving public education, advertising, targeted programmes in schools and workplaces, and the provision of better labelling to enable the public to make more informed decisions (Foresight, 2011).

1.5 Young Consumers

Young people are a new type of audience, an increasingly smart consumer group, who have the power and potential in relation to consumption, both directly as consumers themselves and indirectly by influencing parents' choices and consumption. Truly in 80% of the cases, they control the final purchase decision (Benn, 2004; Lindstrom, 2004).

Teenagers are the best consumer group for fast food companies: around 20% of the kcal come from fast food meal which is generally based on large proportion of meat and dairy (Harris, 2013).

Moreover, tweens start to have consumer experiences and learn consumer preferences, attitudes and behaviors, many of which will persist during the rest of their adult life (Lachance, 2007). It is about preparing them with the skills they need so that they consume in a conscious way and understand their role as actors in the economic system (EUC, 2017). Young consumers represent the future of society and they play a key role in determining patterns of consumption (Hume, 2010; UNESCO, 2011).

Due to these arguments, young consumers are ideal candidates for raising awareness of sustainable consumption.

1.6 Food Labels

Another significant aspect, which could help in promoting sustainable food choices, is the meaning of the food labels and their association with environment aspects. There are consumer labels for ecology, for animal welfare, for the environment, for fair trade and for health. Their purpose is to make easier for consumers to choose the right products by appearing as informative symbols. In this way, the consumer labels serve as guides towards a desired behaviour. However, a paradox seems to have arisen between the purpose of the consumer labels and their complexity (GCSD, 2013) New research has shown that shoppers who actively seek out sustainable and ethical food struggle to find what they are looking for and are generally "overwhelmed and confused" by the vast range of different labels in use (Andersen, 2012). Therefore, a clearer understanding of each of the labels meaning could promote more informed purchases.

Labelinfo.ch is an information service on environmental and social issues, managed since 2001 by the Pusch Foundation. Providing information in French and German on 135 labels is by far the largest database of labels in Switzerland. This service allows consumers to inform themselves objectively and guide their choices responsibly (Labelinfo.ch, 2017). In collaboration with Helvetas, the FRC Consumer Federation and WWF Switzerland, the Pusch Foundation has evaluated the 31 most important sustainability labels in the agro-food market and has published the rating in a guide. The objectives of this evaluation were objective information and guidance for consumers, the promotion of market transparency for labeled products and the improvement of labeling systems. Only food labels covering more than one aspect of sustainability and present at the national level or in large parts of Switzerland were evaluated (Labelinfo.ch, 2017).

1.7 Gamification

Gamification is defined as the use of game design elements in non-game contexts (Infographics.com, 2017). During recent years the enhancement of gamification, has become an outstanding development both in academia and industry (Hamari, 2014) The purpose of using gamification is to create a sense of playfulness in non-game environments so that participation becomes enjoyable and desirable (Thom, 2012). The process of game-thinking to engage users and to "solve problems" encourages, drives engagement, strengthens skills, and behavior changes (Brian, 2013). Actually, games foster feeling of competence (i.e., self-efficacy) through feedback and rewards, and support feeling of relatedness through social connection, competition and cooperation (Bleumers, 2012).

When the concept of gamification is applied to education, the opportunities for experiential, lifelong learning grow exponentially. Learners are hooked by fun and then rewarded with knowledge and skills (Brian, 2013). In other words, by turning the experience into a game, including some reward for achievement, games can produce unprecedented behavior changes (Zichermann, 2011).

The analysis of needs, motivations, and obstacles allows one to check whether gamification is an effective and efficient strategy to achieve the target outcome. This is the case if the following questions can be answered in the positive (Werbach, 2012).

- Does the activity connect to an actual user need?
- Is lacking motivation a central issue or opportunity (and not, e.g., poor usability)?
- Does the target activity involve an inherent challenge with a learnable skill?
- Is affording experiences of competence the most effective and efficient way of improving motivation (and not, e.g., defusing fears)?

Since the answers to all questions are positive, gamification is an applicable approach for raising awareness of food choices.

Morschheuser with a 41 articles examination and 25 gamification experts interviews, concluded that most gamification models follow a similar process that can be divided into seven phases: (1) Project preparation: all activities that have to be executed before the project starts; (2) Analysis: activities that are used to identify the necessary knowledge of users, processes and the project itself; (3) Ideation: activities to come up with ideas for gamification designs; (4) Design: designing of gamification approaches and creation of prototypes; (5) Implementation: Implementation of a gamification approach; (6) Evaluation: Evaluation and testing of the gamification approach; (7) Monitoring: Monitoring of the gamification approach after the release (Morschheuser, 2017).

1.7.1 Project Preparation

A recommended way to start is to identify the problems that should be addressed via gamification and to derive goals that could be used to measure the success of the gamification project. The main purpose of this phase is to clarify the gamification project's objectives, so activities such as the definition and ranking are recommended (Fitz-Walter, 2015; Klevers, 2016). In order to simplify the complex theme of sustainable food choices, the most important aspects were selected.

- Learn what an environmentally-friendlier diet means. It is a synonym for a diet with little CF and therefore with low GHG emissions (acknowledge that the CF is an index used to assess the relationship between food production/consumption and GHG emission)
- Distinguish the diverse environmental impacts of food category according to their CF
- CF of local food vs exported: to learn that the contribution in GHG of transportation is minimal because it is the production which is the most significant stage
- CF of organic vs. conventional production, smaller CF for only some food categories
- CF of seasonal vs. greenhouse heated food
- Recognize the environmental involvement of the food labels.
- Discover meat substitute.

Therefore, to achieve the project's objective, the above-mentioned learning goals have to be learned by means of the game.

1.7.2 Analysis of Context and Users

It is central that both the topic that should be gamified, as well as the understanding of the target group, are clear and well defined (Morschheuser, 2017).

The theme of sustainable food choice is already complicated and abstract. Therefore, one of the objectives of the game was to make the theme more understandable. Having real example of food choices was a valid way to simplify the topic and therefore make it less abstract. Also, giving examples of products that can be bought in Swiss grocery stores offered the possibility to tackle the learning goal of understanding food labels more easily.

Teenagers are an interest target group since they are in the phase of "building themselves" while facing strong and manipulating social pressure (Hume, 2010b). Middle-High school is a period of disorientation where adolescents try to define their style and outlook on life. It is a period of "ego formation" and "identity" (Ingall, 1997). They are beginning to choose their way of life and they are very concerned about their self-image (Wiley, 1998). Thus, the game was developed in order to allow students to experiment with their own preferences and play as protagonists.

1.7.3 Ideation

In literature there is a lack of detailed process of selecting and combining building blocks in order to design a concrete gamification approach (Deterding, 2015). What is very clear is that games consist of one or more interconnected challenges a player must try to overcome (Morschheuser, 2017). In order to cover the above-mentioned objectives while considering the context and the users the game that was develop is a role-playing game. Indeed role games allow the players to acquire knowledge, build and validate models and use these in the decision-making process (Bousquet, 2002).

Additionally, another purpose of developing the game, was to design a tool that teachers, educators or families can use for promoting the theme of environmentally-friendly diets while having fun and spending time together. Hence, the game could not be a "virtual-video game", but rather had to be a board game.

1.7.4 Design of Prototype and Evaluation

After the collection of ideas, the next step was to develop a concrete gamification design. This step consists of the elaboration of "playable" prototypes. It is recommended to create fast prototypes, e.g. in the form of paper to rapidly test the success of the design idea. Indeed, successful gamification approaches occur when ideas and designs are frequently tested and improved until they appear to be successful (Morschheuser, 2017).

The aim of the evaluation phase is to investigate, whether the developed prototype meets the defined objectives. Several approaches to evaluate a gamification design can be used. Playtesting was the method used for evaluating the prototypes. This method entailed the observation of the users that were given an assignment in a game (Fitz-Walter, 2015).

In the chapter 2, the development stages of six prototypes and the related evaluations that led to the final version will be described.

1.8 Aims

The aim of the project was to develop a game able to raise awareness of sustainable food choices among young consumers. In order to achieve this aim, the game had to be designed so that by playing, the following learning goals were acknowledged. The first learning goal was to understand what an environmentally-friendlier diet means, which is a synonym for a diet with little CF and therefore with low GHG emissions (acknowledge that the CF is an index used to assess the relation between food production/consumption and GHG emission). The second learning goal was to learn that the food category (animal vs plant) is the most significant element for determining environmental-friendliness. Indeed, the production of raw material is the stage that contributes most to the total GHG emissions along the food chain. Also, by way of the game, players had to learn that the contribution in total GHG emissions of the transportation stage is less important than the food category, but that local foods are anyway environmentally-friendlier than imported food products. The same applies for seasonal food items which are not subjected to the heating of greenhouses, and for the organic production for some food categories. Moreover, the players, by means of the game, had to learn the environmental involvement of the food labels and discover meat substitute products.

In order to assess the efficacy of the game intervention, the change increase in knowledge and the liking of the game were assessed.

2 Development and evaluation of the prototypes

In the next section, the development stages of six prototypes that led to the final version will be described. For each prototype the background, the development process, the evaluation and the discussion will be reported.

2.1 Memory Game

2.1.1 Background

This prototype was developed before having defined the specific learning goals of the game. Actually, it was the tool used to check whether gamification was a valid approach for raising awareness of sustainable diets. The game was designed for one of the activities of the Summer School "Ferienplaush" (Pro Juventute, 2017). Within this three-day course, 8-15 years old students discovered the multiple aspects of the agro system.

The already existing game Memory, served as a basis for the development of the prototype that was supposed to cover the topic of the environmentally-friendly diets. Memory is a famous card game in which the players have to pair matching cards (Wikipedia, 2017). In this version, the goal is to pair food products with the respective environmental impact that was assessed by the following environmental indicators: Carbon Footprint (CF), Water Footprint (WF) and Ecological Footprint (EF). The WF, is a human appropriation of freshwater resources in terms of volumes of water consumed and polluted (Ercin, 2012). In the case of food production/consumption, also called virtual water, it is the water required for the processes of the life cycle of the food (BCFN, 2015). The unit of measurement is the water use expressed in m3 of water needed. The consumption of water can lead to environmental impacts related to human health, ecosystems and water resource depletion (Humbert, 2015). The EF calculates the Earth's capacity, the amount of biologically productive land (or sea) required for supplying the resources and absorbing the emissions associated with a production chain. It is measured in global square meters per kilogram or liter of food (BCFN, 2015).

The rules of the game are basically the same as in the original version with some additional actions: The player 1 picks up one pair cards (footprint and food item) and he/she has to state if the number of footprints, hence the environment impact, is right for the picked food card. The player 2, who holds the list with the ranked food items, confirms whether the player 1 answered correctly. If yes, and the 2 cards matched, the player 1 can take the cards and play once again. If player 1 answered correctly, but the cards don't match, the player 1 has to say if the number is higher or lower. If he guessed right, he can play again until he guesses wrong. Then the players change their roles.

2.1.2 Development

The first step was to assess the CF, the WF and EF for each food product. The values of the three environmental indexes were taken from the BCFN database (BCFN, 2015). For each indicator, food items were ranked from the lowest to the highest value and divided approximately into 3 categories: low environmental impact = 1 footprint, medium environmental impact = 2 footprints and high environmental impact = 3 footprints (see Appendix figs. 9, 10 and 11).

PowerPoint was used to design the game materials, consisting of 3 different game sets, one for each environmental indicator. One set contains 16 food item cards, the relative matching 16 footprint cards and the environmental indicator chart (see Fig. 2, and Appendix figs. 12 and 13).

2.1.3 Evaluation

The game was played twice with 2 different groups of students. At the end of the game session, the students were asked to give feedback orally. In general, the students answered that they enjoyed playing more than they enjoyed listening to a presentation. Also, they liked to win using their skills. What they did not like was having to wait their turn while the other player was guessing all the cards correctly.

2.1.4 Discussion

This prototype was the tool to check whether gamification was the proper method for this project. It was confirmed that students are more willing to learn when they can actively participate and put their skills to good use. Indeed, the students could enthusiastically experience a difficult and abstract theme as the one of the relationship between food production/consumption and the use of resources.

Nevertheless, the game presented some limitations. The first one, was the waiting time between each turn, which bored the players. Therefore, for the development of the next prototype, it was considered to get rid of the waiting time by having dynamic rounds. Also, the memorizing activity did not give much incentive to learn more about the topic.

In conclusion, the development of this prototype showed that in order to design a game several aspects have to be considered and that a valid design has to be organized before the prototype is built.

Fig. 2 Memory game

2.2 Collecting Ingredients (Prototype 1)

2.2.1 Background

The general idea of the game is to collect ingredients around the world (board map Appendix fig. 33), in order to prepare definite recipes. Each ingredient has to be paid according to the "CF money", which is based on the kg of CO_2-eq of kg of ingredient and according to the real retail price. Although it was not included in the game learning objectives, to better integrate the table game picturing the world, the EF was also added. The EF is "payed" by erasing areas on the board map, so as to show that the production/consumption of food also contributes to land depletion.

The goal of the game is to prepare different meals by spending as little CF money as possible which means having the environmentally-friendliest dishes and use the least land as possible. The goal is achieved by replacing animal based ingredients with plant substitutes and by buying organic, seasonal and local ingredients. Ultimately, it is also possible to confront the ingredients from a nutritional point of view.

2.2.2 Development

Data of CF, EF and nutritional facts were collected for several food items. A CF and EF food database of 80 food items was created. In order to crate the board map, the CF of transportation for different means was assessed (table 3) and the distance from the country of origin to Switzerland was calculated from the website (Distance, 2017). In order to give a real example of a meal and to show the nutritional facts, healthy and balanced recipes from the Swiss Society for nutrition were selected (SGE, 2017).

Using Microsoft PowerPoint the ingredients cards depicting the country of origin (as to calculate the contribution of the transport), the CF for organic and conventional production, the real grocery price, and the EF and the nutritional facts were designed. For animal-based ingredients, substitute plant based cards were designed (see fig. 3 and Appendix figs. 14-28). Fig. 3 shows an example of meal, in this case a breakfast recipe card with the relative ingredient cards.

Table 3 Average of CO_2 for transport means

Mode of Transport	***Carbon Footprint*** *(g CO_2 /kg km)*	***References***
Road-Truck	0.062	(ECTA, 2011; Jorgensen & Ywema, 1996; Sim et al., 2007; Spielmann & Scholz, 2005; Weber & Matthews, 2008)
Rail-Train	0.022	
Sea-Boat	0.016	
Air-Airplane	0.602	

Fig. 3 Collecting ingredients game

2.2.3 Evaluation and Discussion

This prototype was not evaluated by playing, but it was presented to the supervisors of the project. The following aspects emerged from the discussion. The first concern was that the game was excessively complicated, due to the too many calculations involved and due to the large amount of information. Secondly it was challenging to compare the CF of the different recipes since the CF had to be calculated first for each ingredient. Also, since the recipes were given, the player could not really play according to his/her own preference and taste, which was intended to be one of the purposes of the game.

Therefore, as to improve this version, the above-mentioned points had to be solved. Firstly, the game had to be simplified, which means that calculations had to be excluded and the amount of information had to be reduced. Secondly the game had to allow the players to be the protagonists and to play according to their own wants.

2.3 Burger Game (Prototype 2)

2.3.1 Background

In order to simplify the prototype, several meals were replaced with only one, a burger recipe. The goal basically remained the same; to collect ingredients for preparing the environmentally-friendliest burger, hence with the smallest CF value, while managing a given budget. The Ingredients to collect are: bread, lettuce, tomatoes, cheese and for the patties: beef, pork, chicken, salmon, tofu, beans and Quorn (Appendix table 12). Different motivations led to the choice of using a burger. First because the burger format allows to have a vast selection of meat products and meat substitutes in form of a patty. Second, since the CF values of the ingredients such as bread, lettuce, tomatoes, cheese are constant, it facilitates the comparison of the CF of animal product against plant based products. Third, the patty selection allows players to have more options to choose from. According to their own taste and preferences players can prepare their personal burger and thereby be the protagonist of the game. Last but not least, hamburgers are the staple food of the fast food regime and therefore compatible with young consumer regimes. The first move is to decide where to buy the ingredients from, according to the given budget. Indeed, the ingredient prices change from country to country. In this prototype, the environmental impact was no longer paid with money but with another currency represented by footprints, which each player has in different colours. Once the ingredient is bought with money, the player has to pay the CF by placing the respective footprints on the world map. The winner of the game is the one who has the least number of footprints on the world map. At the end of the game the remaining money is compared.

2.3.2 Development

First the CF of each ingredient was re-evaluated in order to show the different contribution of the first 3 stages of the food chain: production, transport and processing. The ingredient cards (see fig 4 and Appendix figs. 29-32 beef and salmon examples) display the CF value for production and processing, while the value for the transportation has to be calculated by taking the data from the world map table. The player can decide which means of transport is used for carrying the ingredients: airplane, truck, train and boat. Each mean has a different monetary cost and CF (table 3). The more environmentally-friendly the vehicle is, the more expensive it is, and vice versa, the more polluting the cheaper. The division into stages of the CF, was done in order for the player to realize that it is the production, which is the stage that contribute the most in total GHG emissions. Later, the prices of the ingredients were collected according to the different countries of origin. The units of measurement were removed and the EF was eliminated from the game. Two more extra ingredients were added, the non-seasonal lettuce and non-seasonal tomatoes. This was in order to show that out of season products have a higher CF value due to the heating of the greenhouse. For checking the seasonality, the WWF seasonal vegetable calendar was provided (see Appendix fig. 39).

2.3.3 Evaluation and Discussion

The game was evaluated by playing and feedback from the players were noted. Several constraints came up. The first big problem was the overall execution of the game, since it was chaotic playing with so many cards. Also, it was difficult to compare the food items, because once again the total CF had to be calculated. Indeed, with this version it was not possible to completely tackle the problem of calculations. Furthermore, the ingredients were not realistic, since is not normal to find beef from Asia or Africa in Swiss grocery stores. The last point was that in this version the food label theme was not presented.

Fig. 4 Burger game

Fig. 5 Burger game, A3 format

2.4 Adaptation Burger Game (Prototype 3)

2.4.1 Background and Development

The prototype was adjusted by considering the limitations that came up from the evaluation of the prototype 2. In order to avoid confusion by the many cards and to easily confront the CF values of ingredients, the ingredients cards were combined in a A3 format sheet (fig. 5 and Appendix figs 34 and 35). For the purpose of present realistic food choices and to show food labels, food products from the main 2 grocery-stores in Switzerland (Migros and Coop) were set as ingredients (table 4). Information about the price, the price per kilogram, the country of origin and the amount of food per package were collected. The CF values were calculated for each ingredient according to the packaging size (table 4). More product options were selected for one ingredient in order to present the diversity of food labels and in order to have more countries of origin and therefore confront the contribution of the transport aspect. The goal and the rules remained the same.

2.4.2 Evaluation and Discussion

With the A3 format sheet information, the game design was improved and the information was made more readable. Moreover, in this prototype the food labels are presented. Despite improvements, the game still had several restrictions. Firstly, the playful aspect, one of the most important components of a game, was missing. Playing the game was not fun because the goal of the game was too trivial and because there was not enough interaction between the players. It could be a game to play alone. Moreover, the limitation given by the calculation of the CF of transport was still not solved. Lastly, game elements that allows players to use their own skills to win were lacking.

Table 4 Ingredients game information I

Type of food	***Price*** *CHF*	***Amount*** *g*	***Price*** *CHF/kg*	***CF Production*** *g CO2-eq /g food*	***CF Processing*** *g CO2-eq /g food*
Beef Burger Qualité&Prix CH	4.25	2x100g	21.25	4'800	600
Beef Burger Naturafarm CH	6.95	4x70g	24.82	6'720	840
Beef Burger Naturaplan organic CH	5.70	2x100g	28.50	4'800	600
Beef Burger Budget CH	10.50	10x100g	10.50	24'000	3'000
Beef Burger Terra Suisse CH	7.50	4x100g	18.75	9'600	1'200
Beef Burger Bio organic CH	4.80	2x100g	24.00	4'800	600
Pork Burger Naturafarm (ground) CH	7.60	400g	19.00	3'200	1'600
Pork Burger (ground) M Classic CH	6.50	350g	18.57	2'800	1'400
Chicken Burger Budget Brazil	9.45	9x100g	10.50	3'600	2'700
Chicken Burger Bell CH	5.95	2x125g	23.80	1'000	750
Chicken Burger CH	5.20	4x90g	14.44	1'440	1'080
Salmon burger Naturaplan Scotland	13.65	2x125g	54.60	2'250	750
Salmon Budget Faroe Islands	4.80	2x125g	19.20	2'250	750
Salmon MSC Ireland	9.95	2x100g	39.80	1'800	600
Salmon burger ASC Ireland	7.90	2x125g	31.60	2'250	750
Tofu Organic CH	4.50	2x125g	18.00	125	500
Tofu Organic Almanatura EU	3.30	2x200g	8.25	200	800
Quorn Burger EU	5.50	2x100g	27.50	1'200	0
Beans Burger China	3.60	2x100g	18.00	100	300
Cheese slides CH	2.50	10x20g	12.50	2'400	400
Cheese slides budget CH	2.80	20x20g	7.00	4'800	800
Bread buns USA	1.90	6x57g	5.56	103	239
Bread buns American IP-Suisse CH	2.90	6x50g	9.67	90	210
Tomatoes classic Spain	4.95	500g	9.90	250	250
Tomatoes Naturaplan Spain	2.95	250g	11.80	125	125
Tomatoes Organic Italy	3.75	300g	12.50	150	150
Tomatoes Primagusto CH	4.70	350g	13.43	175	175
Lettuce Zurich	2.95	250g	11.80	125	125
Lettuce Naturaplan ch	2.95	250g	11.80	125	125
Lettuce France	2.30	250g	9.20	125	125
Tomatoes classic Spain out season	4.95	500g	9.90	1'250	250
Tomatoes Naturaplan Spain out season	2.95	250g	11.80	625	125
Tomatoes Organic Italy out season	3.75	300g	12.50	750	150
Tomatoes Primagusto CH out season	4.70	350g	13.43	875	175
Lettuce Zurich out season	2.95	250g	11.80	625	125
Lettuce Naturaplan ch out season	2.95	250g	11.80	625	125
Lettuce France out season	2.30	250g	9.20	625	125

2.5 Burger Debate (Prototype 4)

2.5.1 Background

The biggest limitations encountered in the previous prototype were, the lack of interaction and the absence of the playful aspect. In order to solve these constraints, the structure of the game was changed. The general idea remained the same, buy ingredients to prepare the environmentally-friendliest burger, but in this version, the game is played in the form of a debate. The idea on which the game was based is that the students acknowledge the learning objectives by the means of the motivations used by the different players.

The players play in 3 diverse roles: as consumers, as producers and as the environment. The debate begins with the purchase of the ingredients by the consumer. He/she has to buy bread, tomatoes, lettuce, cheese and a patty, for making a personal burger, according to his/her preferences and budget. At the same time, the producer and the environment must convince the consumer, with their own motivations, to let the consumers buy what they want. The producer has the most expensive ingredients, since they should allow him to make the most profit. Those food products are generally organic, local and animal based. While the environment's ingredients are those with the lowest CF, so organic, local and plant based. What happens is that for the local and organic products the two players agree, while for the food category they will go against each other.

2.5.2 Development

The A3 format of the information sheet remained the same, but the information about the ingredients were separated according to the relevance with each respective role. In the consumer's sheet, the information was the ingredient's price, the quantity, the cost per kg, the country of origin and the food labels. While the producer's sheet displayed: the ingredient's profit, the profit per kg of ingredient, the country of origin and the food labels. In the literature, no data was found regarding the percentage of profit from the purchase price of food. The two main Swiss shops were contacted, but neither provided any information, as that kind of information is strictly confidential. The information was obtained from a Zurich grocery store owner, who sells products directly purchased from Swiss farmers without intermediaries in the sales process. He pays 70% of the sale price to the farmers while he explained that normally Swiss farmers receive only about 10-15%. Consequently, the profit of the producer was set as the 10% of the sale price (table 5). The environment's sheet contained information about the county of origin of the ingredients, the food label and the CF values expressed in g of CO_2-eq for g of food for the production and processing stages, while the CF of the transport has to be calculated from the world map. The payment method was changed according to the role. The consumers pay the ingredients with money, the producer receives the 10% of the sold ingredients and the environment pays in footprint currency, that are placed on the world map as to show the impacts of the different consumer's burgers.

2.5.3 Evaluation and Discussion

The game was evaluated by playing and it was found that the implementation of the debate solved some limitations found in the previous prototype. The players interacted with each other by expressing their ingredient arguments. In order to convince the consumer, the producer and the environment used their own argumentative skills as to show who had the greatest motivation. Also, the game in form of a debate proved to be fun because the players could express their imagination and fantasy by creating different roles/characters.

What still did not work, was the display of the information as that was still too complicated and overwhelming as well as the calculation of the CF of transport. Design should facilitate the understanding of information, but in this prototype, it was the opposite, the display of information was making it difficult to understand. In addition, the payment method of the environment further complicated the game and the footprints did not allow a clear understanding of the environmental impact of the burgers.

Table 5 Ingredients game information II

Type of food	***Producer Profit*** *CHF*	***Producer Profit*** *CHF/kg*	***CF Transport*** *g CO_2*	***CF Total*** *g CO_2-eq /g food*
Beef Burger Qualité&Prix CH	0.43	2.13	4	5'404
Beef Burger Naturafarm CH	0.70	2.48	5	7'565
Beef Burger Naturaplan organic CH	0.57	2.85	4	5'404
Beef Burger Budget CH	1.05	1.05	19	27'019
Beef Burger Terra Suisse CH	0.75	1.88	7	10'807
Beef Burger Bio organic CH	0.48	2.40	4	5'404
Pork Burger Naturafarm (ground) CH	0.76	1.90	7	4'807
Pork Burger (ground) M Classic CH	0.65	1.86	6	4'206
Chicken Burger Budget Brazil	0.95	1.05	168	6'468
Chicken Burger Bell CH	0.60	2.38	5	1'755
Chicken Burger CH	0.52	1.44	7	2'527
Salmon burger Naturaplan Scotland	1.37	5.46	28	3'028
Salmon Budget Faroe Islands	0.48	1.92	40	3'040
Salmon MSC Ireland	1.00	3.98	22	2'422
Salmon burger ASC Ireland	0.79	3.16	28	3'028
Tofu Organic CH	0.45	1.80	5	630
Tofu Organic Almanatura EU	0.33	0.83	22	1'022
Quorn Burger EU	0.55	2.75	11	1'211
Beans Burger China	0.36	1.80	49	449
Cheese slides CH	0.25	1.25	4	2'804
Cheese slides budget CH	0.28	0.70	7	5'607
Bread buns USA	0.19	0.56	51	393
Bread buns American IP-Suisse CH	0.29	0.97	6	306
Tomatoes classic Spain	0.50	0.99	37	537
Tomatoes Naturaplan Spain	0.30	1.18	19	269
Tomatoes Organic Italy	0.38	1.25	16	316
Tomatoes Primagusto CH	0.47	1.34	7	357
Lettuce Zurich	0.30	1.18	0	250
Lettuce Naturaplan ch	0.30	1.18	5	255
Lettuce France	0.23	0.92	10	260
Tomatoes classic Spain out season	0.50	0.99	37	1'537
Tomatoes Naturaplan Spain out season	0.30	1.18	19	768
Tomatoes Organic Italy out season	0.38	1.25	16	915
Tomatoes Primagusto CH out season	0.47	1.34	7	1'057
Lettuce Zurich out season	0.30	1.18	0	750
Lettuce Naturaplan ch out season	0.30	1.18	5	754
Lettuce France out season	0.23	0.92	10	760

2.6 Adaptation Burger Debate (Prototype 5)

2.6.1 Background and Development

In order to solve the problem due to the design, Microsoft PowerPoint was replaced with InDesign. InDesign is an Adobe graphics program which is used for to creating works such as posters, flyers, brochures, magazines, newspapers and presentations (InDesign, 2017).

To make the design clearer and more pleasant, the complicated tables were eliminated and replaced by an image of a burger. Since the goal of the game is to prepare the environmentally-friendliest burger the main object of the design had to be a burger itself. The first step to draw the shape of a burger by hand. The drawing was then scanned and modified in InDesign. The information of the respective roles was added by the use of a typical label figure.

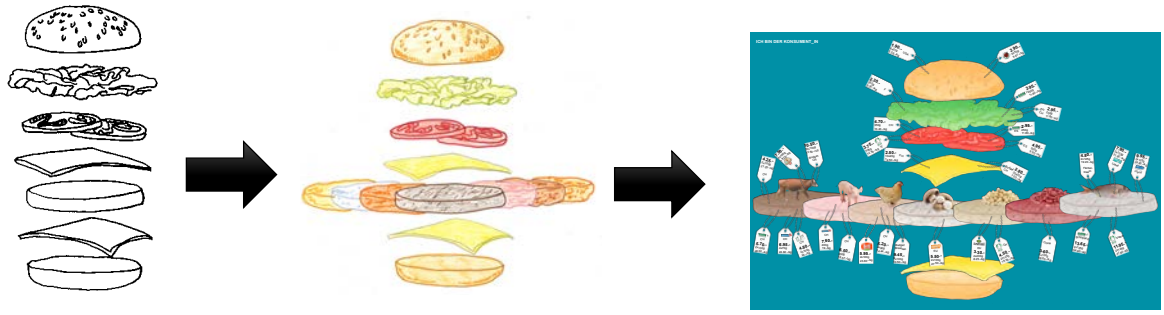

Fig. 6 InDesign Burger evolution

The 3 sheets (Appendix figs. 36-38) contained the same information as the previous version, with the difference that in the environment sheet the CF is now express in terms of money, 1 g of CO2-eq equivalent corresponds to 1 CHF. This change was made in order to fix the environment payment of the previous version. Also, in this way the game was simplified because all the players only use one currency. In order to finally fix the problem of the CF calculation of the transport, the world map was eliminated and the CF values of the transport were calculated and integrated into the environment's sheet (table 5). In addition, label meaning cards (Appendix figs. 53-57) were developed in order to clarify the meaning of the ingredient labels and in order to provide helping arguments for the producer. The cards display the meaning of the label and 3 scores describing the brand's commitment to safeguarding the environment, respecting animals and respecting labor standards. The information is based on the Pusch label evaluation (Labelinfo.ch, 2017). The last thing that was added, were the packaging pictures of the ingredients, so that the players had tangible examples of the food choices.

2.6.2 Evaluation

2.6.2.1 Implementation

With this prototype the first evaluation with students was done. The game was played in a 3rd year class of the school "Moosmatt" in Urdorf, which is the school that registered for the "Forshung zum Aufassen" project. Overall, the execution of the game was satisfying. The students understood the rules, the objectives of the game roles and the general theme clearly. Nevertheless, the majority of them were neither interested nor enthused to play. This was mainly reflected in the performance of the debates. The students had to be encouraged to talk and to motivate the ingredient choices. This restriction may be due to the age of the students. In fact, it is typical for young people of this age to be ashamed to expose themselves and express own thoughts for fear of judgment. On the other hand, the two teachers were enthusiastic about the game. One of them even held on to the game prototype in order to re-propose the activity in other classes.

2.6.2.2 Knowledge Increase and Liking

In order to assess whether the game was a valid method to raise awareness of sustainable food choices, the change of knowledges was evaluated. The objective of the assessment was to evaluate whether there was an increase in the notions concerning the environmental-friendliness of food consumption and production. The method used for the evaluation was a quiz. The quiz was filled out a first time before playing the game and then a second time a week after playing. So, if the game was suitably developed and therefore was a valid method for raising awareness, there had to be an increase of right answers after playing the game. Furthermore, the game itself was evaluated by means of a liking form.

<u>Participants and Procedure</u>

The game session took place on November the 6th 2017 at the Moosmatt school in Urdorf, during the cooking class. Fifteen 14-15 year old students (two boys and thirteen girls) took part in the evaluation. The students were asked to individually fill out the quiz. The quiz, (see Appendix fig. 68) which consisted of ten questions, was elaborated as to evaluate the set learning goals that were supposed to be acknowledged by means of the game: environmental-friendliness of the stages along the food chain, organic and conventional production, local and imported food and most importantly the food category (animal vs. plant), and the meaning of a food label. The score for each question was calculated as follow, 1 point per right answer (table 6). Therefore, the maximum attainable score was 16 points.

Table 6 Questions score I

Question	***Score***
2,4,6,7,10	1 point
1,3	2 points
5,8	3 points

After about 7 minutes the quizzes were collected and the game was presented. To play the game, the fifteen students were divided into two group of seven and eight students. Within the group the roles were established, three to four students played the role of consumers, two students the producer and two students the environment. One game set, which enclosed: one consumer sheet; one producer sheet; one environment sheet; fake money, pictures of the ingredients, label meaning cards, a seasonal vegetable calendar and sheets for taking notes, were provided to each group. The rules and the goal of each role were explained. The students played for about 45 minutes. After the game, they were asked to individually fill out the linking form (Appendix fig. 60), which asked questions regarding useful aspects for the game's potential improvement. One week after the game, the students filled out the same quiz for the second time.

Data Analysis and Results

Descriptive statistics and SPSS Statistics, version 23 (IBM) were used to analyse the results. Mean differences were assessed with the paired-sample t-test, and Pearson correlation coefficients were reported. The test is based on a 0·05 significance level. For the t-tests, the test values are reported. The evaluation scale given in the liking form, which goes from 0 to 10 was divided into three parts: 0-3; 4-6 and 7-10 and the average of answers was then calculated for each part.

A total of 15 students filled out the first quiz (before the game), and 15 students filled out the second test (one week after the game). The quiz was anonymous, so the numbers displayed in the different charts do not necessarily refer to the same student. For instance, the students who answered one question of the second quiz may not have answered the same question of the first one. Students who did not play the game were not asked to fill out the quiz, so there is not a control group to compare the results to. The number of correct answers was analysed and the results were plotted in the diagrams.

Table 7 Score results I

Questions	*Total student score before*	*Total student score after*	*Percentage before*	*Percentage after*
1. What do you think is eating more sustainable? (2p)	12	19	40%	63%
2. Which of these does not affect the sustainability of a food? (1p)	5	7	33%	47%
3. What is the meaning that a food has a big environmental impact? (2p)	15	13	50%	43%
4. The type of food makes no difference in terms of sustainability, only the transport counts? (1p)	7	8	47%	53%
5. If a food label says “organic”, what does it mean? (3p)	15	19	33%	42%
6. Which of the following generally accounts for the largest portion of greenhouse gas emission when it comes to food? (1p)	11	8	73%	53%
7. Which of the following patty is the eco-friendliest? (1p)	0	7	0%	20%
8. When are tomatoes in season? (3p)	14	16	31%	36%
9. Which of these helps to measure how sustainable something is? (1p)	4	3	27%	20%
10. Cheese from Switzerland is eco-friendlier than chicken from Brazil? (1p)	2	7	13%	47%

Table 7 shows the score for each question for all students and the total score. This number was calculated adding up the scores obtained by all the students for each question. In the quiz before the game, a total number of 15 students gained 85 points (M= 5.66, SD = 3.73) which corresponds to 35% of the total score, while in the second quiz after the game, the 15 students obtained 103 points, (M= 6.88, SD = 4.05), 42% of the total score. The number of correct answers improved of 8% in the second quiz, but the total score was very far from the maximum score. After the game, there was no longer any question with a zero score. Table 7 shows the percentage of correct answers, for each question of the quiz, both before and after the game. The most improvement in a score was for question 10 with 33%, while the largest decrease of 20% was for question 6. The statistical analysis of the total score before and after the game, for the t statistic t = -1.818 and p = .51, showed no significant improvement in knowledge.

Table 8 Results of the liking I

Characteristics	***0-3***	***4-6***	***7-10***
Complexity	Easy 0%	Right 60%	Difficult 40%
Instruction	Easy 27%	Right 53%	Difficult 20%
Uniqueness	No 27%		Yes 73%
Time	Too short 13%	Okay 27%	Too long 60%
Design	Not like 0%	Okay 10%	Like a lot 90%
Theme	Boring 13%	Okay 60%	Funny 27%
Interest	No 13%	Okay 53%	Very 34%
Play again	No 0%	Once 60%	Often 40%
Wait time	Too short 0%	Okay 60%	Too long 40%
Game dimensions	Too small 0%	Okay 60%	Too big 40%

Table 8 shows the results of the liking evaluation form filled out by 15 students. 90% of the students really liked the game design (n= 14), while 10% (n=1) did not find it pleasant. For the question “would you play the game again”, all the students answered that they would play it at least one more time (not play again n=0), 40 (n=6) would play often and 60% (n=9) would play only once. The game’s theme was found fun by 27% students (n=4), okay by 60% (n=9) and boring by 13% (n=2). 34% (n=5) of the students found the game interesting, 53% (n=8) found it was okay and 13% (n=2) did not find it interesting at all. The duration of the game is directly dependent on the student’s motivations during the debates. If they have many arguments to use for motivating their wants, the time would be longer and shorter than if they do not argue. For 60% (n=9) the game session was too long, for 27% (n=4) it was just right and for 13% (n=2) the time was too short. Related to the game time session, 40% (n=6) of the students found the waiting time during the game rounds too long, while 60% (n=9) found it okay.

2.6.3 Discussion

Although overall there was no significant increase in knowledge, there was a slightly improvement for individual questions. For questions 7 and 10, which are questions about the impact of the food category, there was a score increase of 20% and 33% respectively. This means that the prototype 5 allowed at least to recognize that, animal products are less environmentally-friendly than plant based products. Also, for question 1 there was an improvement of 23%, which means that after the game, it becomes clearer what having an environmentally-friendlier diet means. Indeed, before the game 53% of the students answered that a way to eat more sustainable was by having a diet with low fat intake. There was no improvement for the questions 2 and 5. Both questions asked about the difference in environmental impact among the phases of the food production chain. This may due to the lack of argumentations by the environment players. Indeed, to convince the consumer to buy the most sustainable ingredients, the environment should explain the difference in GHG emission between production, processing and transport stages. The same can be stated for question 5, about the meaning of organic production. The answer should derive from the label meaning cards used by the producer to argue his choices. Without that argumentation, it is in fact not possible to get the information about the meaning of the labels. Question 9, which was about the indicator used to assess the environmental-friendliness, did not raise in score. This is perhaps due to a lack of game data explication during the game instruction.

Therefore, a first conclusion was that in absence of right argumentations from environment and producer players, there could not be an increase in knowledge of the production stage impacts and of the meaning of organic production. Without arguments, there was also a slight increase in knowledge of food category impact. In order to understand the overall theme, more detailed information about game data has to be given.

Generally, the students liked the game itself, the design, the theme and they were interested in the theme and would like to play at least once again. They evaluated the waiting time negatively, which was evaluated too long.

In order to increase the significance of the evaluation, other teachers were contacted with the purpose of testing the game in more classes and so increase the number of the evaluations. To resolve the language problem that I faced with the class in Urdorf (Zurich) I contacted Italian speaking teachers, and to avoid the lack of attention and motivation typical for the age group of the students with whom we played, teachers of a high school (Ticino) were contacted. They reacted positively to the game idea and proposed to play in 6 classes.

2.7 Adaptation Burger Debate (Prototype 6)

2.7.1 Background and Development

The first change was translating the game information from German into Italian. Secondly, in order to enclose the theme of nutrition, wanted by the teachers, nutritional fact cards for the ingredients were created. Nutritional data were collected from the nutrition fact labels displayed on the food product packaging. Thirdly, consumer's goals, which differ in the number of the burgers to prepare, in budget availability and in nutritional needs, were elaborated. By way of those, players discovering nutritional properties, especially of meat and meat substitute products. Also, the consumer player has to take into account the size of the packaging in order to have the lowest amount of waste possible.

- Couple with high blood pressure, lowest salt intake, 15.- (Ha, 2014)
- Buy the ingredients for a burger party with 10 people, 22.-
- Weight lifter, highest proteins intake, 13.- (Tipton, 2001)
- Carbo-loading before a marathon, highest carbs intake 20.- (Rowlands, 2002)
- Couple with renal problems, lowest proteins intake, 20.- (Bellizzi et al., 2016)
- Free choice, 20.-

With the implementation of these objectives the consumer is also part of the debate. In response to the producer and environment arguments, consumers have to motivate the reason of the selected ingredient from a nutritional or from a budget point of view.

Moreover, a person in charge for regulating the debates and to manage the money was needed. Therefore, the role of a judge was introduced. In order to incentivize the player to properly argue the ingredient choices, which are important for the acknowledgment of the learning goals, debate points were also added. The Judge has the task to assign points to the players, who use the best argumentations and who manage to convince the consumer to buy what he wants.

To summarize, the overall goals are:

- Consumers: manage the budget, evaluate the ingredients from a nutritional point of view in order to achieve the nutritional needs
- Producers: earn as much as possible by convincing the consumers to buy the most expensive products and gain debate points. An aid for the arguments is given by the label meaning cards.
- Environment: to pay as little as possible, which means having the lowest environmental impact by convincing the consumers to buy the most environmentally-friendly ingredients and gain debate points. An aid for the arguments is given by pictures of global warming consequences, such as thawing of the glaciers, or the dryness of the soil.
- Judge: manage the execution of the game, collect money from consumers and from the environment and pay the producers. Assign debate points for the best argumentations and regulate the debates.

Fig. 7 Playing the game

2.7.2 Evaluation

2.7.2.1 Implementation

The execution of the game was a success. The students were totally engaged in their roles, and they motivated their ingredient choices by using valid, articulate and imaginative arguments. The success was also confirmed by the teachers., who want to propose the game as a fixed activity for their lessons related to the theme of climate change. For this reason, in January we will have a meeting with the Educational office of Canton Ticino, in order to evaluate the potential of the game. According to one teacher; with the right corrections and improvement, the game can be a valid tool to teach the theme of sustainable diets. Moreover, during the next semesters the game will be played in other classes.

2.7.2.2 Knowledge Increase and Liking

Since the objectives of the assessment were the same as for the previous prototype, the evaluation methods were not changed. While some questions of the quiz were changed in order to be able to evaluate the updated game version better.

Participants and Procedure

The game was played in 6 high school classes, two 3rd grade and four 2nd grade classes, adding up to a total of one hundred and twenty-eight students aged 16-18. Firstly, they filled out the quiz (Appendix fig. 59). In this quiz version, one question about consumer habits was added, with the purpose of evaluating a possible change in consumption patterns as consequence of a raise in awareness. In addition, instead of asking orally which are the environmentally-friendlies meals, images representing different dishes were used.

The score for each question was calculated as follows: 1 point per right answer for questions 3, 5, 6, 7, 8, and 9, two points for questions 1 and 2 and 3 points for question 4 (table 9). Therefore, the maximum attainable score was 13 points.

Table 9 Questions score II

Question	***Score***
3,5,6,7,8,9	1 point
1,2	2 points
4	3 points

Afterwards, the theme of climate change and the relationship between food production and GHG emissions with the connection to the game data was explained. To play the game, the students were divided into three groups of 7-8 students each.

The 3 game sets contained two consumer sheets, one producer sheet, one environment sheet, fake money, ingredient pictures, label meanings cards, ingredient nutritional fact cards, a seasonal vegetable calendar and sheets for taking notes were also provided. The game session lasted about one hour and ten minutes. Before the end of the lesson the students filled out the linking game form (Appendix fig. 60).

The question about the time session, which was not useful for the game improvement, was substituted with a question about the size of the text. It was more important to know whether the readability of game information was properly designed. A week later during the same lecture the students filled out the quiz for the second time.

Data Analysis and Results

Descriptive statistics and SPSS Statistics, version 23 (IBM) were used to analyse. Mean differences were assessed with the paired-sample t-test, and Pearson correlation coefficients were reported. The test is based on a 0·05 significance level. For the t-tests, the test value t is reported. The evaluation scale given in the liking form, which goes from 0 to 10 was divided into three parts: 0-3; 4-6 and 7-10 and the average of answers was then calculated for each part.

A total of 128 students filled out the first quiz (before the game), and 126 filled out the second test (one week after the game). The quiz was anonymous, so the numbers displayed in the different charts do not necessarily refer to the same student. Students who did not play the game were not asked to fill out the quiz, therefore there is not a control group to compare the results to. In order to analyse the change in knowledge, the number of correct questions will be analysed. The results obtained by the students are plotted in the diagrams.

Table 10 Score results II

Questions	*Total student score before*	*Total student score after*	*Percentage before*	*Percentage after*
1. What do you think is eating more sustainable? (2p)	198	232	77%	92%
2. What is the meaning that a food has a big environmental impact? (2p)	201	230	79%	91%
3. the type of food makes no difference in terms of sustainability, only the transport counts? (1p)	107	122	84%	97%
4. If a food label says “organic”, what does it mean? (3p)	198	288	52%	76%
5. Which of the following stage generally accounts for the largest portion of greenhouse gas emission when it comes to food? (1p)	31	110	24%	87%
6. Which of the following burger is the environmental-friendliest? (1p)	25	102	20%	81%
7. Which of the following meal is the is the environmental-friendliest?	50	109	39%	87%
8. Which of these helps to measure how sustainable something is? (1p)	66	122	52%	97%
9. Which of the following meal is the environmental-friendliest? (1p)	133	159	52%	63%
10. Is environmental friendliness a criterion that you take in consideration for evaluating your food choices? (yes)	100	95	78%	75%

Table 10 shows the score for each question for all the students and the total score before and after. This number was calculated by adding up the scores obtained by all the students for each question. In the first quiz a total number of 128 students earned 1009 points (M= 7.88, SD= 5.74), 56% of the maximum score, while in the second quiz a total of 126 students gained 1474 (M= 11.70, SD= 5.45), 84% of the maximum score. The score improved by 27% in the second quiz with a score of 245 points. There was an improvement for each question and none of the scores decreased for any of the questions. As table 10 shows the most improvement in a score was for question 5 with 63% and the least with 13% was for questions 2 and 3. The interpretation of the t-test, t statistic t= -6.041 and p =.000, showed a significant increase in knowledge.

Question 10 concerning consumer habits, questioned whether the adjective sustainable would be a criterion used for determining food choices in the future. Before the game 78% of the students (n=100) answered positively. After the game 5 students changed their minds and 75% of the students (n= 95) responded negatively.

Table 11 Results of the liking II

Characteristics	***0-3***	***4-6***	***7-10***
Complexity	Easy 32%	Right 48%	Difficult 20%
Instruction	Easy 37%	Right 42%	Difficult 31%
Uniqueness	No 3%		Yes 97%
Time	Too short 4%	Okay 63%	Too long 33%
Design	Not like 2%	Okay 10%	Like a lot 88%
Theme	Boring 1%	Okay 11%	Funny 88%
Interest	No 2%	Okay 13%	Very 85%
Play again	No 8%	Once 38%	Often 54%
Game dimensions	Too small 2%	Okay 69%	Too big 29%
Text dimensions	Too small 6%	Okay 84%	Too big 10%

122 students (6 students had to leave before the end of the class) filled out the first page of the liking form, while 117 students (some of them did not see the second part) filled out the second page. 88% of the students liked the design a lot (n= 108), while 10% (n=12) find the game design okay, and 2% (n= 2) did not like it. The game's theme, was found to be fun by 88% students (n=102), okay by 11% (n=13) and boring by 1% (n=1). Indeed, 85% (n=101) of the students found the game very interesting, 13% (n=15) found it was okay and 2% (n=2) found it not interesting at all. For the question "would you play the game again", 54% (n=63) answered they would play again often, 38% would play at least once more (n=15) and 8% (n=8) would not play again. The game size was found to be too big by 29% (n=34) of the students, 69% (n=81) found it was okay and 2% (n=2) found the size too small. For the size of the text 84% of the student (n=108) found it okay, 10% (n=13) considered it too big and 6% (n=7) too small.

Following student's comments and suggestions:

- I would not change anything, I found it very interesting. At the beginning, it was a bit complicated to understand the rules, but once I understood them it was very fun and at the same time you gain a better understanding of the food reality.
- I had fun, but if I had to change something I would round off the prices, because the fake money doesn't have the -.5 coins
- Brilliant! I am vegan due to respecting animals but now I can also say that with my diet regime I am helping the planet. I would extend the game to all the high school classes in order to teach all students the effect food has on the world.
- I would eliminate the pictures of the food because they increase the mess or I would substitute them with plastic food in 3D.
- I would have more ingredients and more meal options.
- Give more budget to consumers so they could vary the choices of ingredients more.
- I would not change anything, it is perfect as it is.
- It is a very interested topic and I loved to play the game
- Give the right budget to the consumer. I had to little money and I could not buy what I wanted.
- I would like to have more options for the lettuce so that I could have seasonal salad.
- I found the game very interesting and educational, as it is able to teach me something very important while playing.
- I would like to buy the game for my siblings and to play with them while learning important concepts.
- Nice game.
- I would like to have more ingredient options.
- I would like to have the food in 3D.

Fig. 8 Burger debate game

Following teacher's comments and suggestions:

- Create a legend for the information of the environment's sheet.
- Change the burger with another meal, since the hamburger is not seen as a typically healthy meal. Also, give more ingredients and more options for meals.
- Change the producer's and environment's points into a money bonus, in order to be more motivated to argue the choices
- Create a consumer profile card, so that the consumers can their objective read all the time and they can note their choices.
- In order to have motivation clues, also give the producers the nutritional fact cards and give the environment the label cards.
- Create a sheet for each player from which they can read the rules of the game and the objectives for each role.
- Eliminate the ingredient pictures, as they are not useful for the game

2.7.3 Discussion

The statistical analysis of the quiz showed significant increase in knowledge. Therefore, a raise in awareness was achieved. In general, the pre-knowledge was already good, since the students gave 56% right answers. Indeed, the teachers used to cover the topic of climate change and global warning during the second year. The highest increase in score was for question 4 about the meaning of organic production. In the game, the organic products are those that give the most profit to the producer and in fact during the game the producers gave specific information on the meaning of organic to convince consumers to purchase these products. Before the game 11% of students answered that organic production means local production (which is false), while after the game only 4% answered the question incorrectly. Therefore, by the means of the producer's arguments it is possible to have an increase in knowledge of meaning of the organic label. The same is valid for the environment's arguments that allowed to acknowledge the environmental impact of the production stages. Before the game 22% of students answered that it is the production and 80% answered that is the transport that contributes most to the GHG emission (question 5), this is consistent with the general idea that it is the transport which is the least environmentally-friendly stage (Tobler, 2011b; Zagata, 2014). After the game, 87% replied that it is the production the stage with the highest impact and 13% that it is the transport. Before playing the game, detailed information about game data was given. This was significant for increasing the knowledge of the index used to evaluate the environmental-friendliness. For question 8, 52% of the students responded correctly before the game, while after playing the percentage increased to 81%. Moreover, still for the environment's arguments, students also understood that meat products are less environmentally-friendly than plant-based products. Indeed, for the questions 6, 7, and 9 that were about ranking the impact of food items, there was an improvement of 61%, 47% and 14% respectively. The smallest enhancement for question 9 was probably due to the difficulty to rank two vegetarian meals like a veggie burger and a pasta dish with tomatoes sauce.

Students and even teachers enjoyed playing the game and found the game interesting and fun. One student would love to have the game at home so as to play with her family and another would like to play again but with new meals. Indeed, the majority of the students would play at least one more time. Generally, the game was played for about 60 minutes and the students found this period of time to be suitable. To conclude the game is in general liked both by students and by teachers.

Although, there was an increase in knowledge this did not result in a want to change dietary habits. In fact, after the game the number of students who would take sustainability into consideration for food choices in the future was lower than the number of student before the game. So, for those students, an increase in awareness does not necessarily lead to a change in habits.

3 Overall Discussion

The aim of the project was to develop a game that enables a raise in awareness of sustainable food choices among young consumers. The gamification process consisted of the development and evaluation of five prototypes, which allowed the promotion of a final prototype competent to achieve the goal of the project. Results from the quiz of the last prototype showed that the intervention was successful in significantly increasing knowledge. Significant increase in knowledge means that the last prototype was a method that is able "to teach" the different learning goals that were set as fundamental points for understanding the theme of sustainable diets. Subsequently, it will be described how, by means of the prototype 6, the students acknowledged the learning goals, what the limitations of game are and how the game could be improved.

- Learn what an environmentally-friendlier diet means. It is a synonym for a diet with little CF and therefore with low GHG emissions (acknowledge that the CF is an index used to assess the relationship between food production/consumption and GHG emission).

By explaining the data of the environment sheet students understood that CF is an index used to calculate the GHG emissions produced by the consumption / production of food (see question 8, Appendix fig. 59). Additionally, some students who were playing the environment role, argued their wants by saying "g of Co_2- equivalent", rather than just use a simple number value. A limitation is given by the fact that in the absence of explanations of the data, the significance of the environment values cannot be deduced. This limitation is also related to the level of prior-knowledge. Students (as those who played with the prototype 5), who have less knowledge about the climate change topic have more difficulty playing the game, since the theme of the environmentally-friendlier diets is a very complex and abstract subject. Therefore, before playing the game it is advisable to make an introduction of the subject.

- Distinguish the diverse environmental impacts of food categories according to their CF.

The students, thanks to the CF ingredient values and the selection of different patties, realized that animal products generally have a higher CF than plant based products (see questions 6,7 and 9, Appendix fig. 59). Indeed, by using the environment's information they wrote in their notes, the students were able to recognize the environmental impacts for each ingredient. However, understanding can be less effective if they do not write down the values. Indeed, for the Ticino game sessions the teachers introduced the rule that each player must write down the ingredient information of the other players and at the end of the game each of them had to have data related to: the price paid for each ingredient by consumers and the relative nutritional values, the ingredient's producers' income and the payment of the environment for the same chosen ingredients.

This solution worked for those trials, but it cannot be introduced as rule of the game because it is not "playable" or fun and furthermore it feels like an additional activity instead of part of the game. Therefore, this aspect needs to be improved.

- CF of local food vs exported: to learn that the contribution in GHG of transportation is minimal because it is the production which is the most significant stage

With the environment sheet, it was possible to recognize that the impact of the transportation is smaller than the production phase by looking at the values of the same ingredients with a different country of origin (see question 5, Appendix fig. 59). The same could be realized by observing the food categories. For example, comparing Swiss lettuce with Swiss beef steak, which are food products with the same country of origin and therefore have the same CF value for transport, the players recognized that the big difference of CF is for the production stage. The information was acknowledged by the other player through the environment's argumentations, since the environment-player promoted the purchase of plant products even if these were not local, such as beans from China or European tofu.

- CF of organic vs. conventional production: smaller CF for only some food categories.

No question in the quizzes addressed the evaluation of this learning goal. What was evaluated (question 4, Appendix fig. 59), was whether there is an increase in knowledge of the meaning of organic production. However, by observing the game's execution, the environment did not diversify the impact between organic and conventional production, since more importance was placed on the food category. For this reason, in future game tests, a specific question about this learning goal must be included in the quiz.

- CF of seasonal vs. greenhouse heated food.

Just as with the previous leaning goal there was also no question addressing this point in the quiz. However, the student's feedback showed that this point was acknowledged. In fact, they suggested that it would be interesting to have more options for the possible types of lettuce and additionally also substitutes for tomatoes. What happened in some game sessions, was that the environment convinced the consumers not to buy those products, since they would have to pay more if the ingredient was out of season. This is a strategy that has not been considered and even characterizes a limitation of the consumer's choices. Consequently, adding those ingredients would allow the players to also learn about seasonal alternatives. In any case, in order to evaluate the improvement of this aspects learning, a specific question should be added in the next evaluation.

- Recognize the environmental involvement of the food labels.

There was also no question addressed in the quiz for this topic just as with the previous leaning goal. However, by observing the game's execution, it appeared that the students learned the meaning of the labels and their association with environmental aspects when the producers used the label meaning cards in order to motivate their wants. A gain of information is therefore limited by the producer's motivations. If producers do not argue with valid label information, it is not possible to have an increase in knowledge of this topic.

- Discover meat substitutes.

By giving a wide choice of patties, the students could choose between different meat substitutes like tofu, Quorn or pulses. In this assessment, the change of knowledge about the nutritional aspect of the different ingredients was not investigated. In the future, another aspect of the game that can be evaluated is the ability to show the nutritional values of meat substitutes and even more interestingly, that not only animal products are a source of protein.

The first four prototypes were evaluated only from the executions point of view, while the prototype 5 and 6 were additionally evaluated for the effectiveness of intervention. Although the two evaluations cannot be compared, because the target group, game prototype and quiz questions were not the same, they allowed to draw some important reflections. First, the age of the students plays an important role in the execution of the game and therefore in the increase of knowledge. The Prototype 6 was evaluated by playing with 15-18 year old students, who from the beginning showed an interest in the topic. While it was precisely the lack of motivation which was one of the limitation of the execution of the prototype 5, which was played with 13-15 year old students. Although the game was developed in order to allow students to experiment with their own preferences and play as protagonists, younger students were not interested in dealing with a complicated topic such as sustainable diets (Wiley, 1998; Hume, 2010b). Additionally, although the development of different prototypes allowed the development of a prototype that integrated the set of learning goals, through the various stages, there has been a progressive implementation of difficulties in the game itself. The complex structure of the game has allowed to create a dynamic and amusing game, but it was limited by the low motivation of the young students to express their own argumentations. The limitation due to age is also linked to the level of prior knowledge. Younger students, who had not dealt with climate change had more difficulty playing the game, since the theme of the environmentally-friendly diets is a very complex and abstract subject. Therefore, the last prototype is a game more suitable for 15-18 year old students or for students who are already interested in the topic.

The second objective of the project was to evaluate the game itself. The results of the liking form and the feedback showed that the design and the theme have been positively accepted. However, if the game should be used as educational material in schools in the future, input of a professional graphic designer will be sought out in order to make the design more captivating and the display of information

clearer. Furthermore, according to student's and teacher's feedbacks, other changes related to the improvement of the implementation of the game should be made. First, the ingredient pictures which do not have a significant purpose, but in fact contribute to disorder and chaos, should be eliminated. Second, it makes sense to provide the producer players with the nutritional fact cards. Listening to the arguments during the game session, it was possible to recognize that the producers also pointed out the healthiness of ingredients in order to convince the consumers. It is therefore important to provide the environment players with the label meaning cards. With these cards, the environment will have more ideas about its motivations. In order to simplify the instruction and rules of the game, profile sheets will be developed, by which each player acknowledges the goals that should be achieved and in order to have the instructions of the game readily available. Moreover, the judge will no longer award the points to the winners of the debates. The best motivation will be rewarded with money. The producer will be given twice what he earns from the selling an ingredient, while the environment would have to pay half of the price. Regarding the amplification of the choice, more ingredient options, especially for seasonal vegetables will be given, but this would not lead to a change of the burger meal yet. Beforehand it would be further investigated if it is true that the burger transmits a wrong message to students. One of the teacher stated that presenting a burger means the promotion of fast food consumption. But by presenting a big selection of ingredients it can be shown that a typically unhealthy meal such as a burger, with salubrious ingredients, could also be characterized as a healthy meal. Additionally, the selection of patties offers versatility, since it allows the choice of animal products as well as plant based products as meat substitutes.

In addition to the limitations of the game itself, there is also a limitation given by the evaluation method. The quiz was used to assess an increase in knowledge of sustainable diets in general and for specific aspects of the game. The motivation for the raise of awareness was to make young consumer more familiar with the relationship between climate change and food consumption paving the way to an environmentally-friendlier lifestyle. But whether students would be able to transfer their increase in knowledge into real life food choices could not be evaluated. However, this limitation provides a basis for possible further studies. It would be interesting to investigate whether young consumers who played the game will choose an environmentally-friendlier food regime in adulthood compared to young consumers who did not play the game. A further aspect that would be interesting to investigate, is what the motivations are that lead people to change towards environmentally-friendlier diets. Question 10 investigated whether the adjective "sustainable" would be a criterion used for determining food choices in the future. The final score after playing the game decreased compared to the beginning, this meaning that an increase in awareness demotivated some students to have environmentally-friendlier diet. This result not only shows that a raise in awareness does not necessarily lead to wanting to change ones' consumption habits, but it even showed that it could lead to the opposite of the desired behaviour. It would be interesting to know the reasons that led these students to change their minds.

4 Conclusion

The project showed that the use of a game is a valid method in order to raise awareness of sustainable food choices. The theme of sustainable diets is an abstract and complex subject to address to young consumers, but by the use of the gamification method, it was possible to make this topic more understandable. Through the process of gamification, which consisted of the development of various prototypes based on the analysis of the context and the target group and the related evaluations, it was possible to obtain a prototype which is able to increase the knowledge of sustainable diets. The last prototype is not only able to raise awareness of sustainable food choices among young consumers, but is also able to fully satisfy the needs of the teachers. In fact, even before the evaluation of the game's effectiveness, the teachers were already interested in having the game as educational material for their classes. While the game intervention is successful at increasing students' knowledge, it is important that methods to increase the willingness of adopting environmentally-friendlier diets are researched and incorporated into this intervention in order to mitigate global warming (Berners-Lee, 2012) and prevent the raise of global average surface temperatures (Hedenus, 2014).

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Appendix

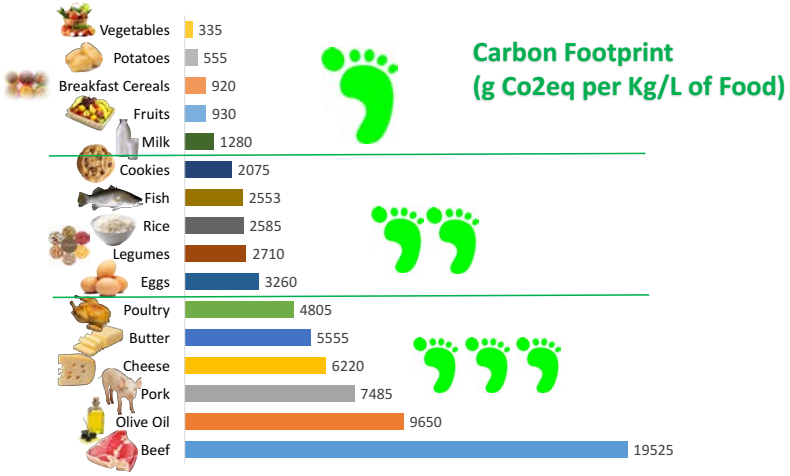

Fig. 9 CF data for memory game

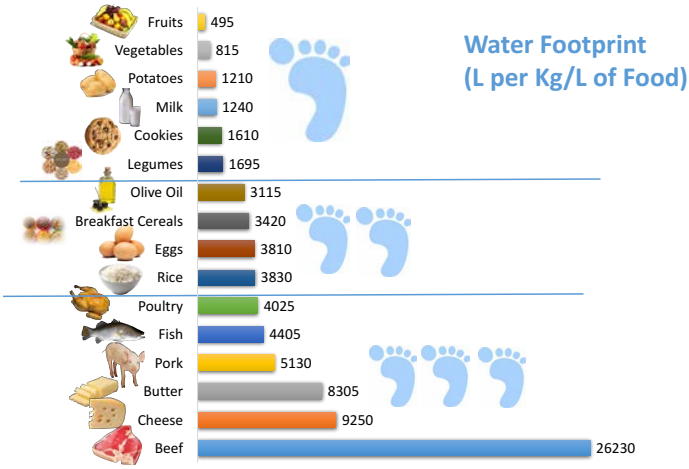

Fig. 10 WF data for memory game

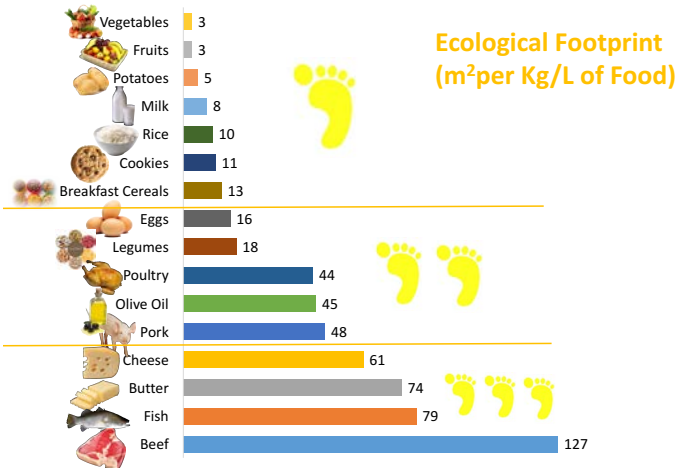

Fig. 11 EF data for memory game

Fig. 12 Memory cards CF example

Fig. 13 Memory cards CF example

Fig. 14 Collecting Ingredients game, recipe card

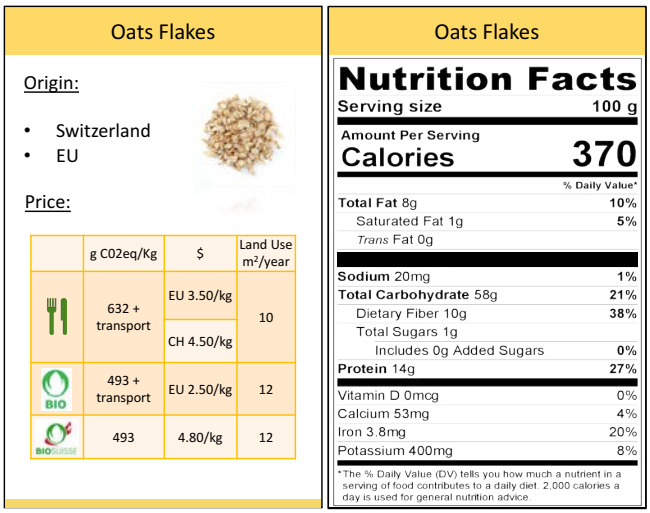

Fig. 15 Collecting ingredients game, ingredient card

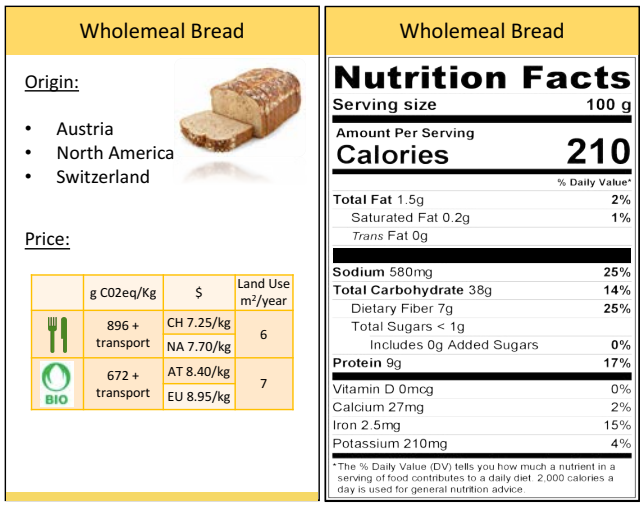

Fig. 16 Collecting ingredients game, ingredient card

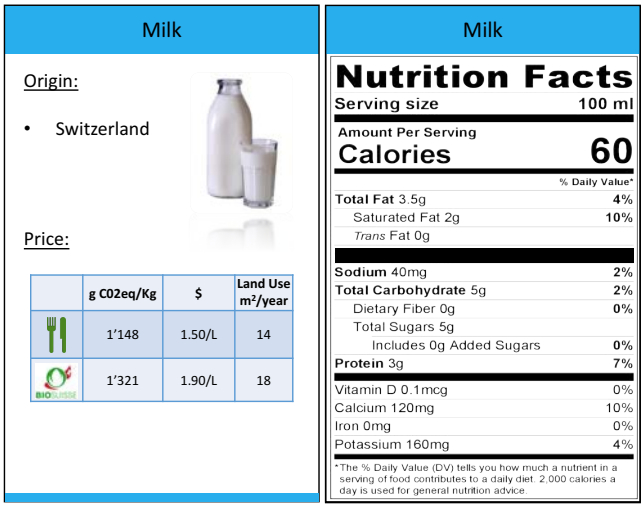

Fig. 17 Collecting ingredients game, ingredient card

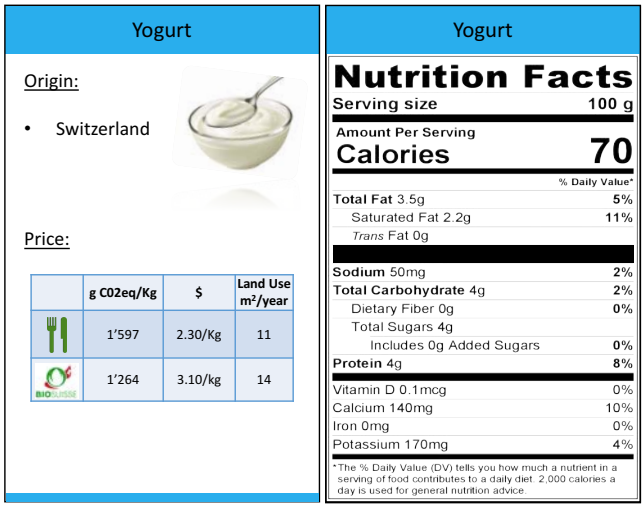

Fig. 18 Collecting ingredients game, ingredient card

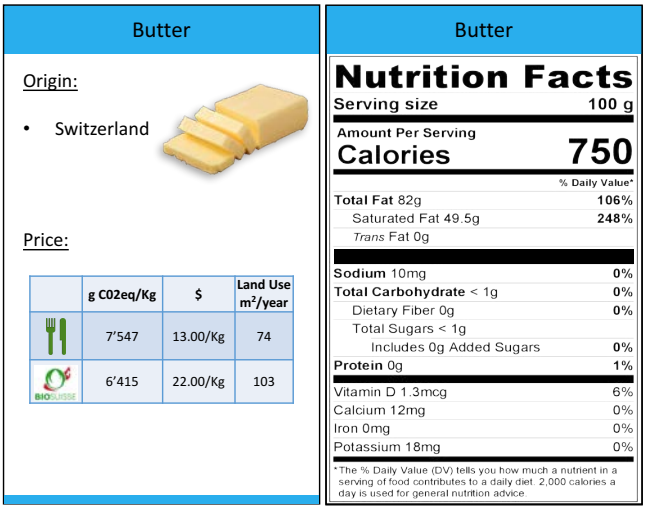

Fig. 19 Collecting ingredients game, ingredient card

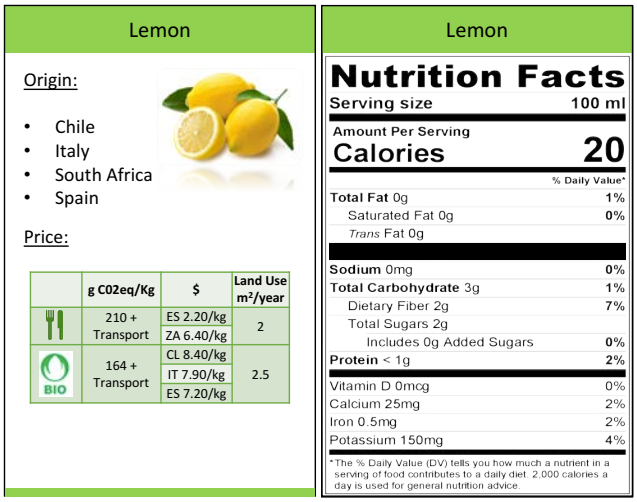

Fig. 20 Collecting ingredients game, ingredient card

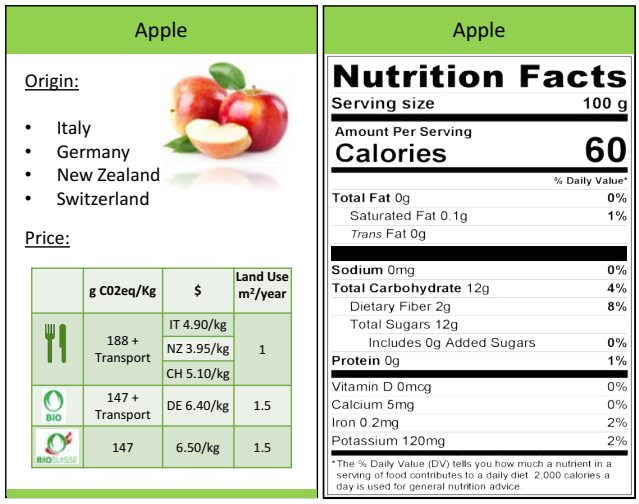

Fig. 21 Collecting ingredients game, ingredient card

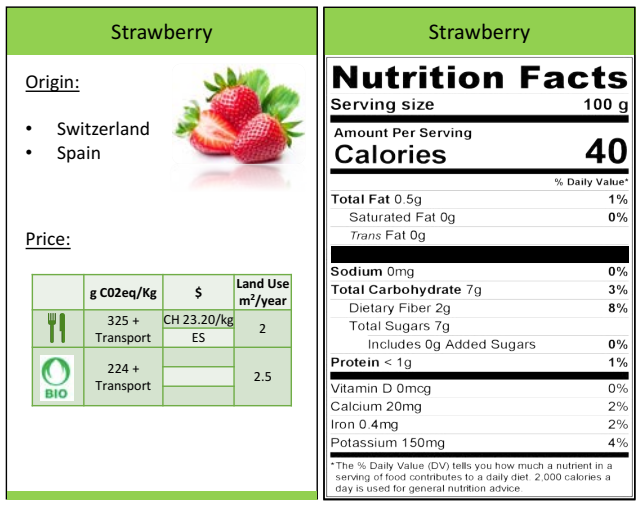

Fig. 22 Collecting ingredients game, ingredient card

Fig. 23 Collecting ingredients game, ingredient card

Fig. 24 Collecting ingredients game, ingredient card

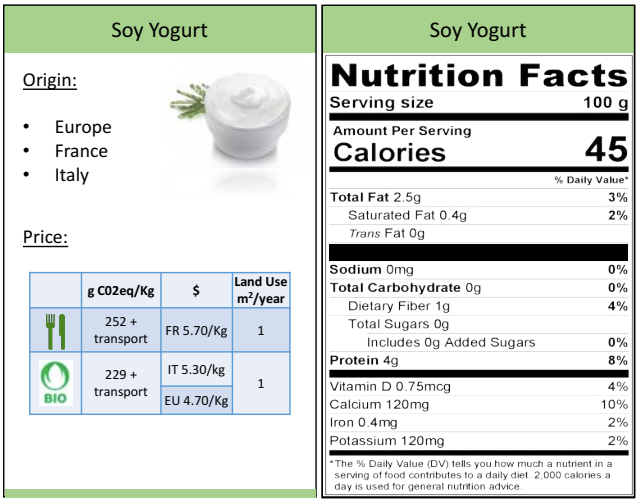

Fig. 25 Collecting ingredients game, ingredient card

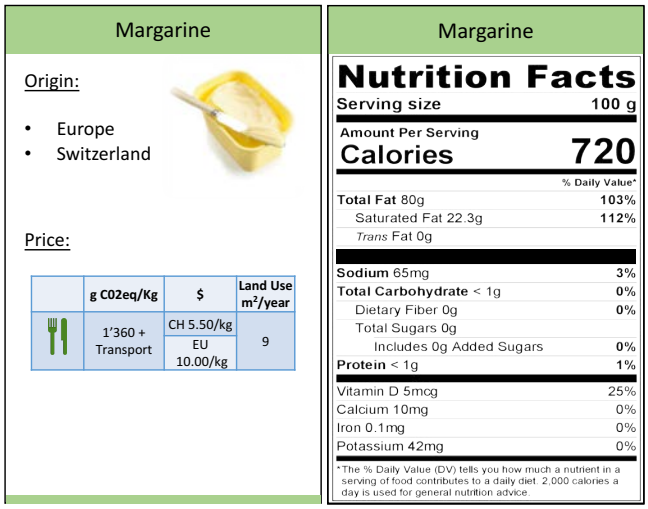

Fig. 26 Collecting ingredients game, ingredient card

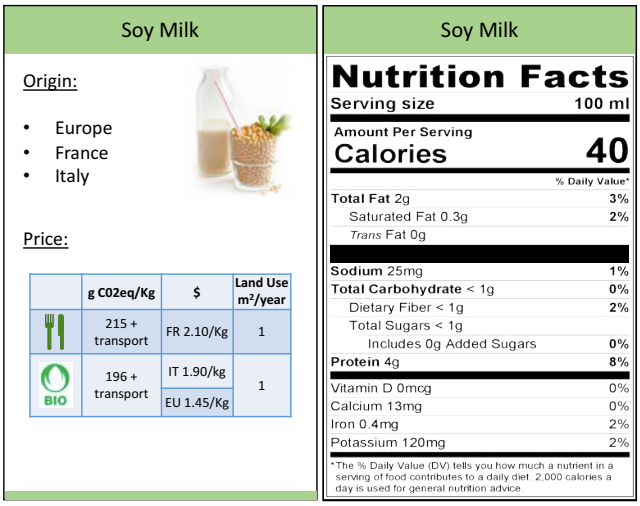

Fig. 27 Collecting ingredients game, ingredient card

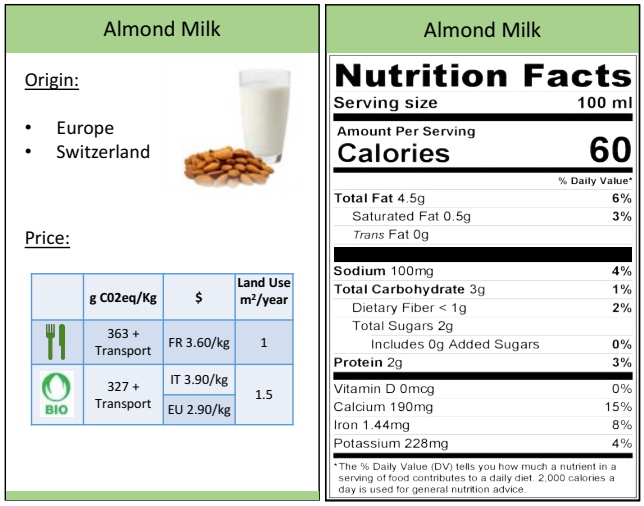

Fig. 28 Collecting ingredients game, ingredient card

Fig. 29 Burger game, recipe card

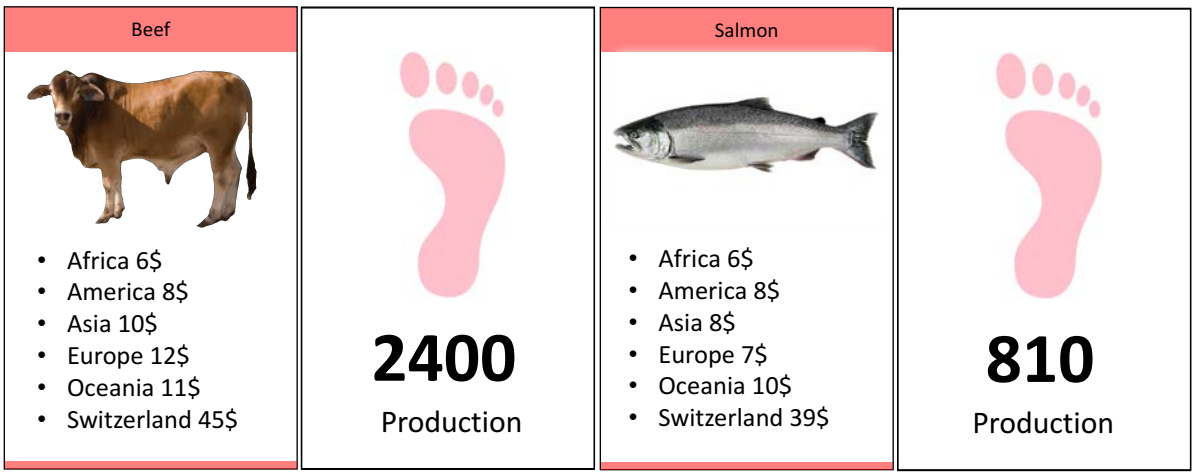

Fig. 30 Burger game, ingredient card example

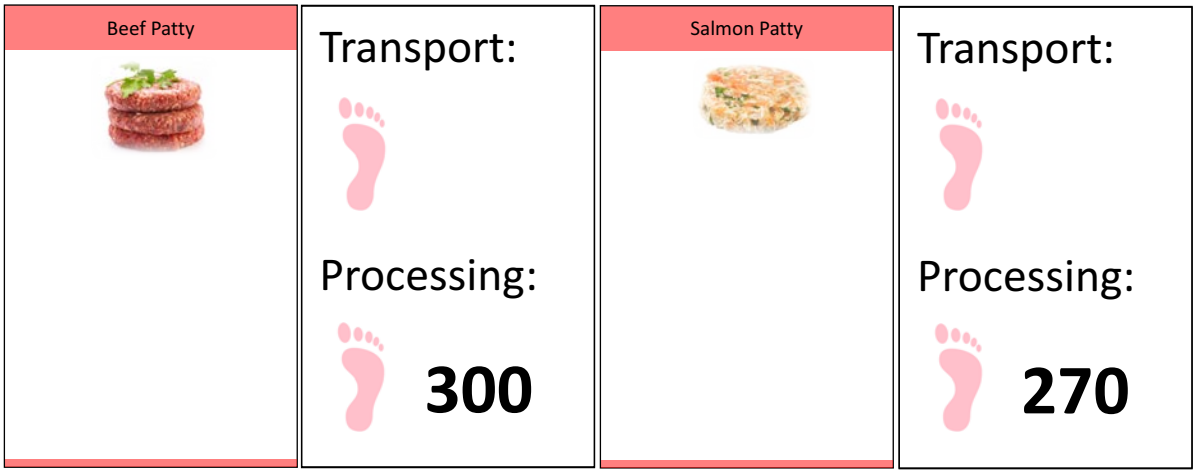

Fig. 31 Burger game, ingredient card example

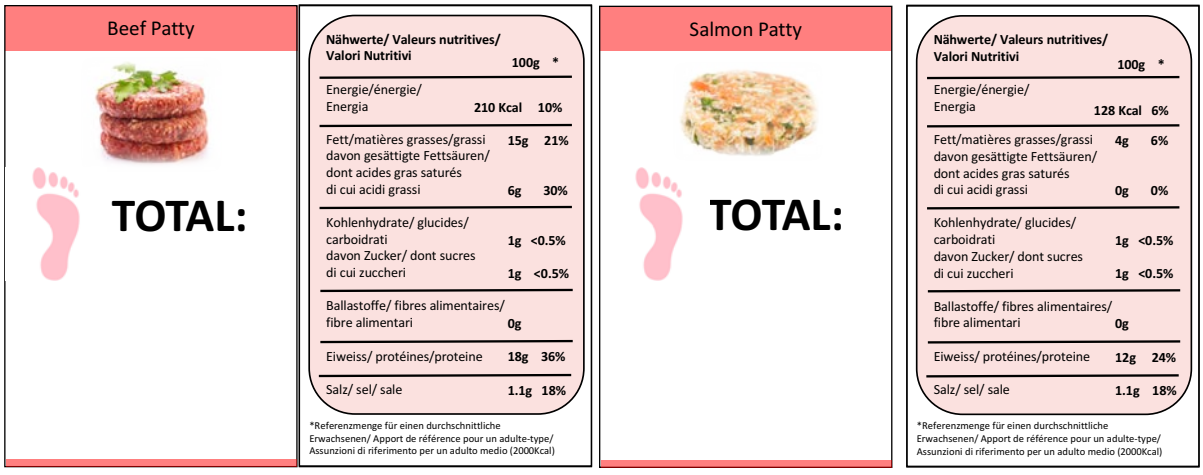

Fig. 32 Burger game, ingredient card example

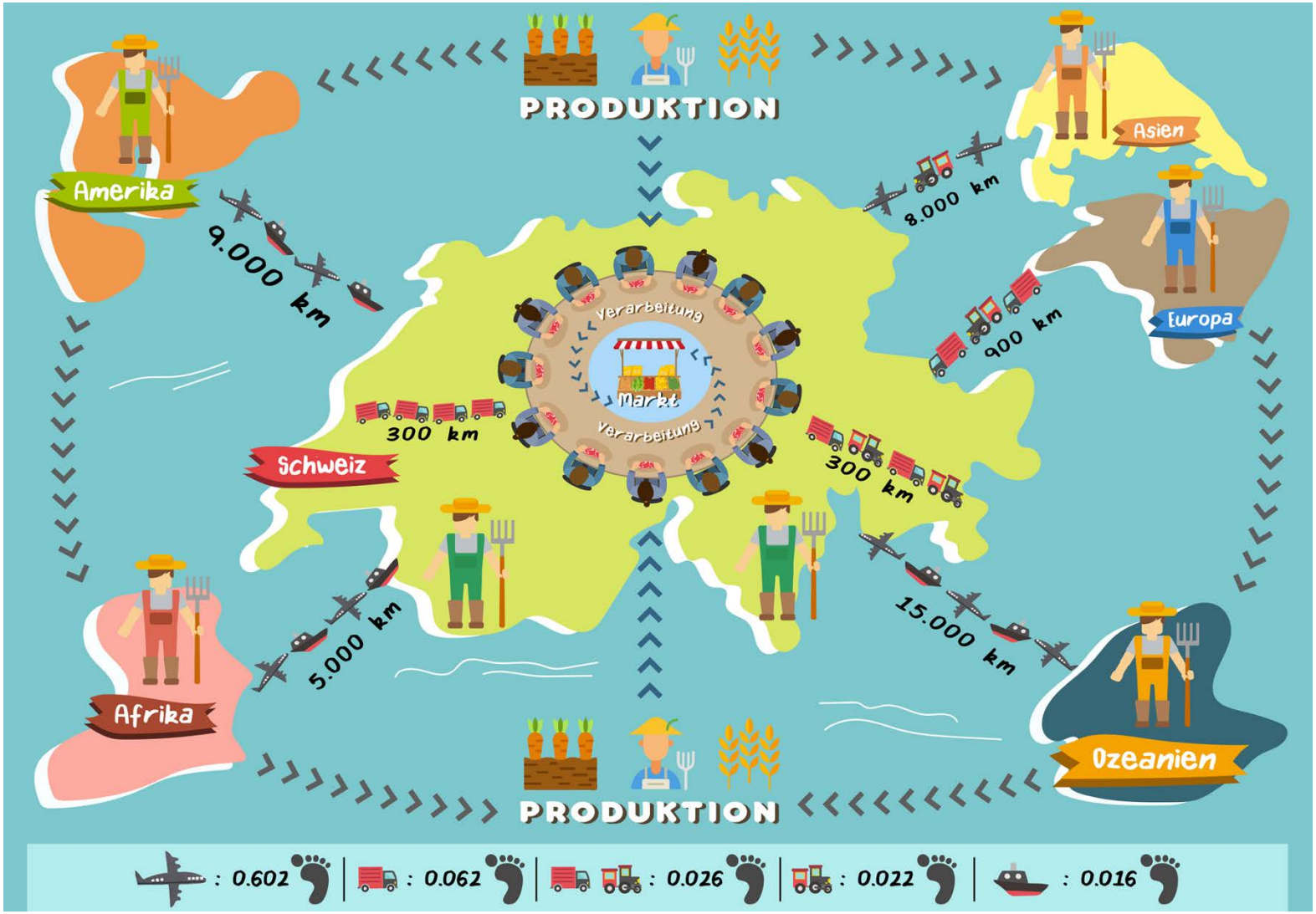

Fig. 33 World map

BURGER MARKT

Rind	Schwein	Poulet	Fisch	Bohnen	Sojabohnen	Pilze
Landwirtschaftliche Produktion **24g Co2eq/g**	Landwirtschaftliche Produktion **8g Co2eq/g**	Landwirtschaftliche Produktion **4g Co2eq/g**	Landwirtschaftliche Produktion **9g Co2eq/g**	Landwirtschaftliche Produktion **0.5g Co2eq/g**	Landwirtschaftliche Produktion **0.5g Co2eq/g**	Landwirtschaftliche Produktion
Verarbeitung **3g Co2eq/g**	Verarbeitung **4g Co2eq/g**	Verarbeitung **3g Co2eq/g**	Verarbeitung **3g Co2eq/g**	Verarbeitung **1.5g Co2eq/g**	Verarbeitung **2g Co2eq/g**	Verarbeitung **6g Co2eq/g**
Rind Burger	**Schwein Burger**	**Poulet Burger**	**Fisch Burger**	**Bohnen Burger**	**Tofu Burger**	**Quorn**
Preis / Preis/100g / gCo_2 eq	Preis / Preis/100g / gCo_2 eq	Preis / Preis/100g / gCo_2 eq	Preis / Preis/100g / gCo_2 eq	Preis / Preis/100g / gCo_2 eq	Preis / Preis/100g / gCo_2 eq	Preis / Preis/100g / gCo_2 eq
5.70 2x100g 2.85 **5'400**	CH 7.60 400g 1.90 **4'800**	CH 4.80 2x100g 2.4 **1'400**	Scotland 13.65 250g 5.50 **3'000**	Classic DE 3.60 200g 1.80 **360**	CH 4.50 250g 1.80 **500**	Classic EU 5.50 200g 2.75 **1'300**
6.95 4x70g 2.48 **7'560**	Classic CH 6.50 350g 1.86 **4'200**	Classic CH 5.20 4x90g 1.44 **2'520**	Ireland 11.95 *250g* 4.78 **3'000**		EU 3.30 *2x200g* 0.83 **800**	
4.80 2x100g 2.40 **5'400**		Budget Brazil 9.45 9x100g 1.05 **6'300**	Classic CH 11.75 250g 4.70 **3'000**			
Classic CH 4.25 2x100g 2.12 **5'400**			Ireland 9.95 250g 3.98 **3'000**			
7.50 4x100g 1.88 **10'800**			Ireland 7.90 250g 3.16 **3'000**			
Budget DE 10.50 10x100g 1.05 **27'00**			Budget DE 4.80 250g 1.92 **3'000**			
Transport gCo_2 eq/t Km	**Transport** gCo_2 eq/t Km	**Transport** gCo_2 eq/t Km	**Transport** gCo_2 eq/t Km	**Transport** gCo_2 eq/t Km	**Transport** gCo_2 eq/t Km	**Transport** gCo_2 eq/t Km
602 x km =	602 x km =	602 x km =	602 x km =	602 x km =	602 x km =	602 x km =
62 x km =	62 x km =	62 x km =	62 x km =	62 x km =	62 x km =	62 x km =
22 x km =	22 x km =	22 x km =	22 x km =	22 x km =	22 x km =	22 x km =
8 x km =	8 x km =	8 x km =	8 x km =	8 x km =	8 x km =	8 x km =
Tot:	Tot:	Tot:	Tot:	Tot:	Tot:	Tot: .....
Total	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**
Preis:	**Preis:**	**Preis:**	**Preis:**	**Preis:**	**Preis:**	**Preis:**
g Co_2 eq:	**g Co_2 eq:**	**g Co_2 eq:**	**g Co_2 eq:**	**g Co_2 eq:**	**g Co_2 eq:**	**g Co_2 eq:**

Fig. 34 Burger game (prototype 3)

BURGER MARKT

Rind	Schwein	Poulet	Fisch	Bohnen	Sojabohnen	Pilze
Landwirtschaftliche Produktion **24g Co2eq/g**	Landwirtschaftliche Produktion **8g Co2eq/g**	Landwirtschaftliche Produktion **4g Co2eq/g**	Landwirtschaftliche Produktion **9g Co2eq/g**	Landwirtschaftliche Produktion **0.5g Co2eq/g**	Landwirtschaftliche Produktion **0.5g Co2eq/g**	Landwirtschaftliche Produktion
Verarbeitung **3g Co2eq/g**	Verarbeitung **4g Co2eq/g**	Verarbeitung **3g Co2eq/g**	Verarbeitung **3g Co2eq/g**	Verarbeitung **1.5g Co2eq/g**	Verarbeitung **2g Co2eq/g**	Verarbeitung **6g Co2eq/g**

Rind Burger

	Preis	Preis/100g	gCo_2 eq
	5.70 2x100g	2.85	**5'400**
	6.95 4x70g	2.48	**7'560**
	4.80 2x100g	2.40	**5'400**
Classic CH	4.25 2x100g	2.12	**5'400**
	7.50 4x100g	1.88	**10'800**
Budget DE	10.50 10x100g	1.05	**27'00**

Schwein Burger

	Preis	Preis/100g	gCo_2 eq
CH	7.60 400g	1.90	**4'800**
Classic CH	6.50 350g	1.86	**4'200**

Poulet Burger

	Preis	Preis/100g	gCo_2 eq
CH	4.80 2x100g	2.4	**1'400**
Classic CH	5.20 4x90g	1.44	**2'520**
Budget Brazil	9.45 9x100g	1.05	**6'300**

Fisch Burger

	Preis	Preis/100g	gCo_2 eq
Scotland	13.65 250g	5.50	**3'000**
Ireland	11.95 *250g*	4.78	**3'000**
Classic CH	11.75 250g	4.70	**3'000**
Ireland	9.95 250g	3.98	**3'000**
Ireland	7.90 250g	3.16	**3'000**
Budget DE	4.80 250g	1.92	**3'000**

Bohnen Burger

	Preis	Preis/100g	gCo_2 eq
Classic DE	3.60 200g	1.80	**360**

Tofu Burger

	Preis	Preis/100g	gCo_2 eq
CH	4.50 250g	1.80	**500**
EU	3.30 *2x200g*	0.83	**800**

Quorn

	Preis	Preis/100g	gCo_2 eq
Classic EU	5.50 200g	2.75	**1'300**

Transport gCo_2 eq/t Km

	602 x	km =
	62 x	km =
	22 x	km =
	8 x	km =

Tot: .....

Total

Preis:

g Co_2 eq:

Fig. 35 Burger game (prototype 3)

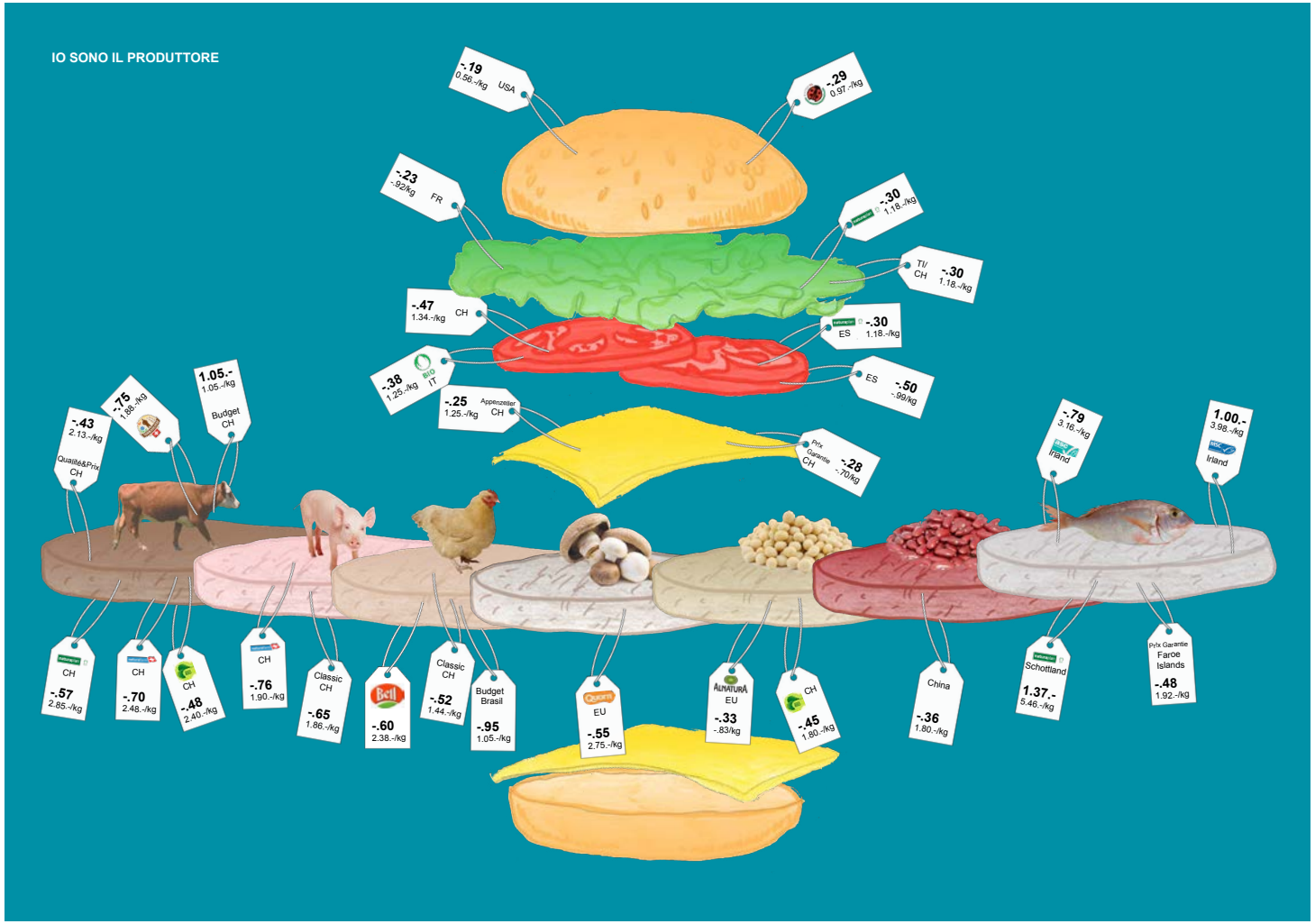

Fig. 36 Burger Debate, producer sheet

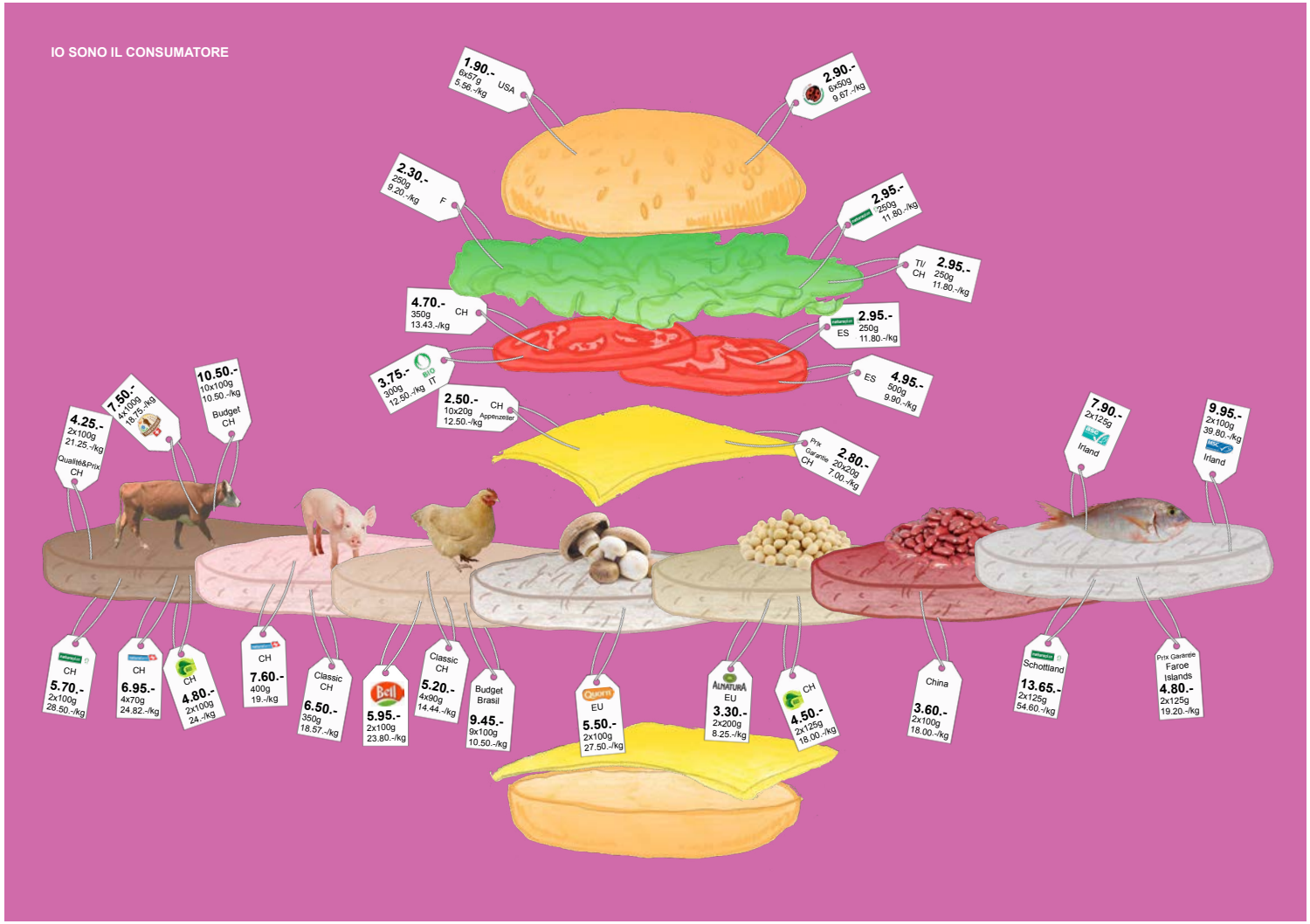

Fig. 37 Burger Debate, consumer sheet

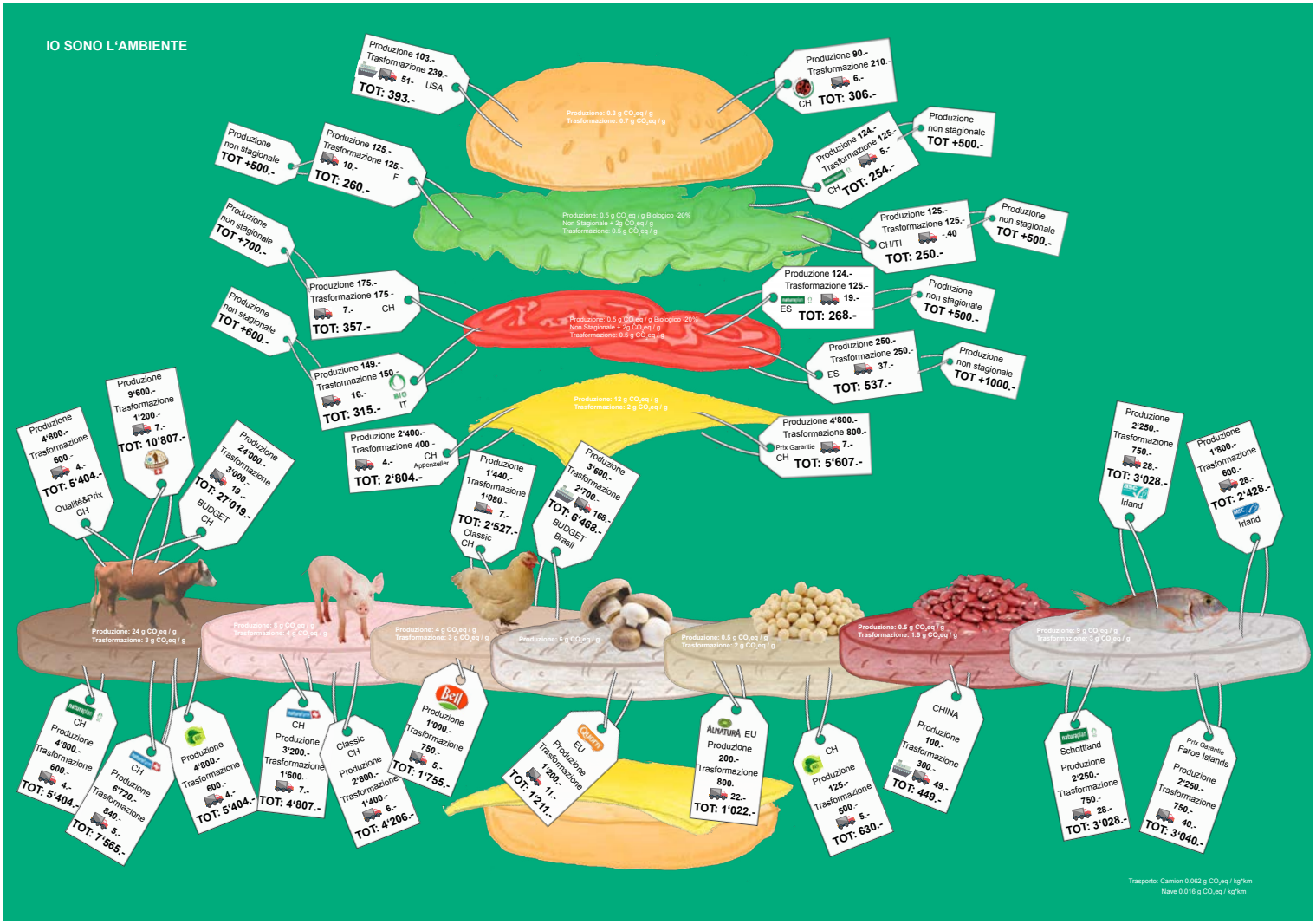

Fig. 38 Burger Debate, environment sheet

Fig. 39 Seasonal vegetable Calendar

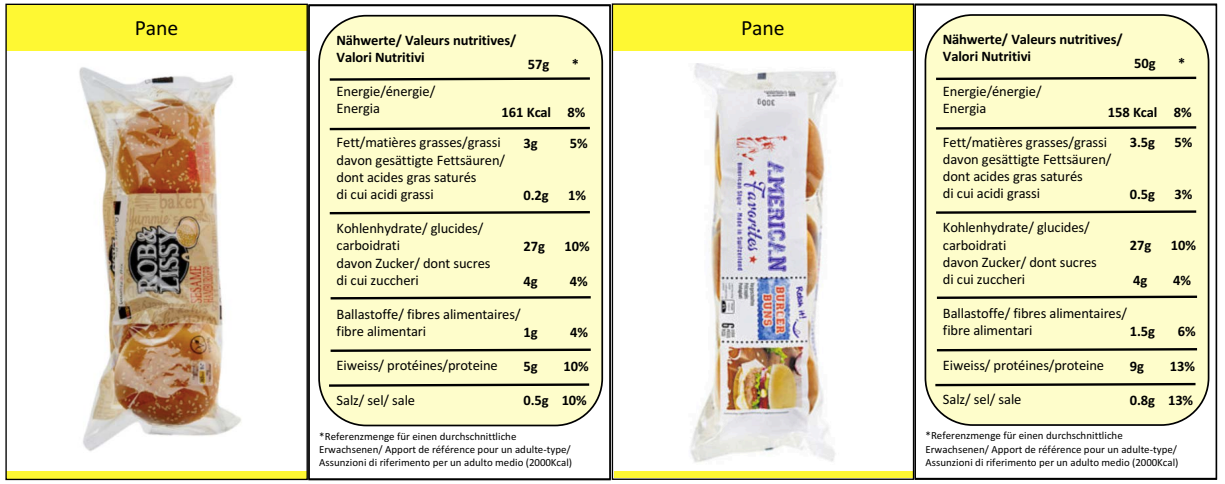

Fig. 40 Burger Debate, nutritional fact cards

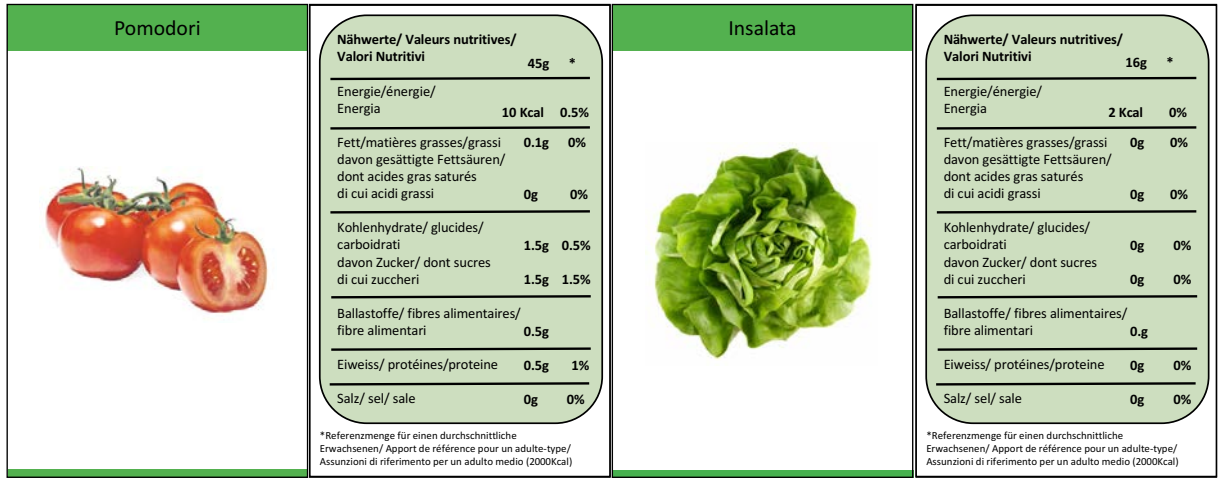

Fig. 41 Burger Debate, nutritional fact cards

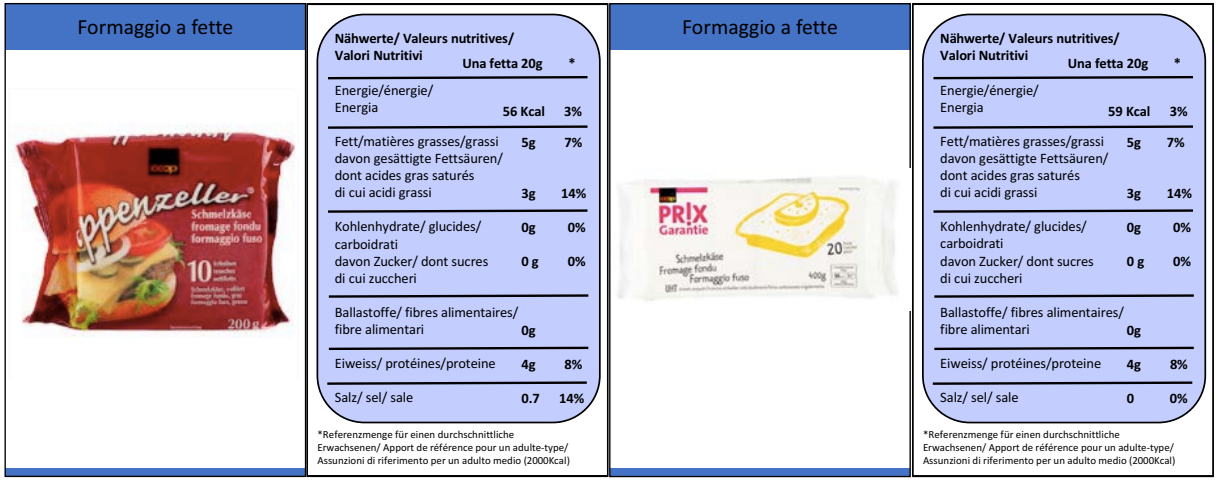

Fig. 42 Burger Debate, nutritional fact cards

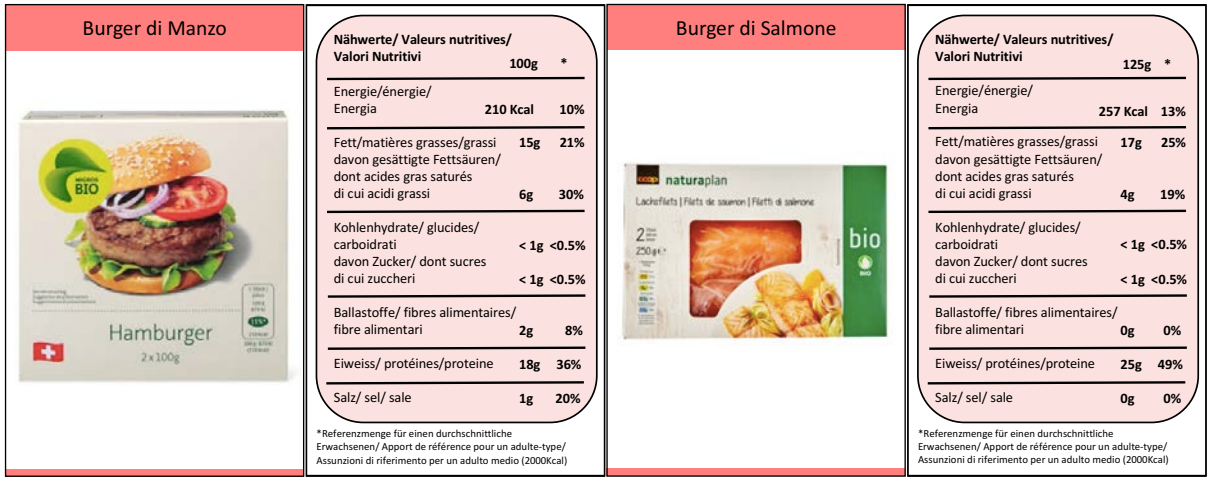

Fig. 43 Burger Debate, nutritional fact cards

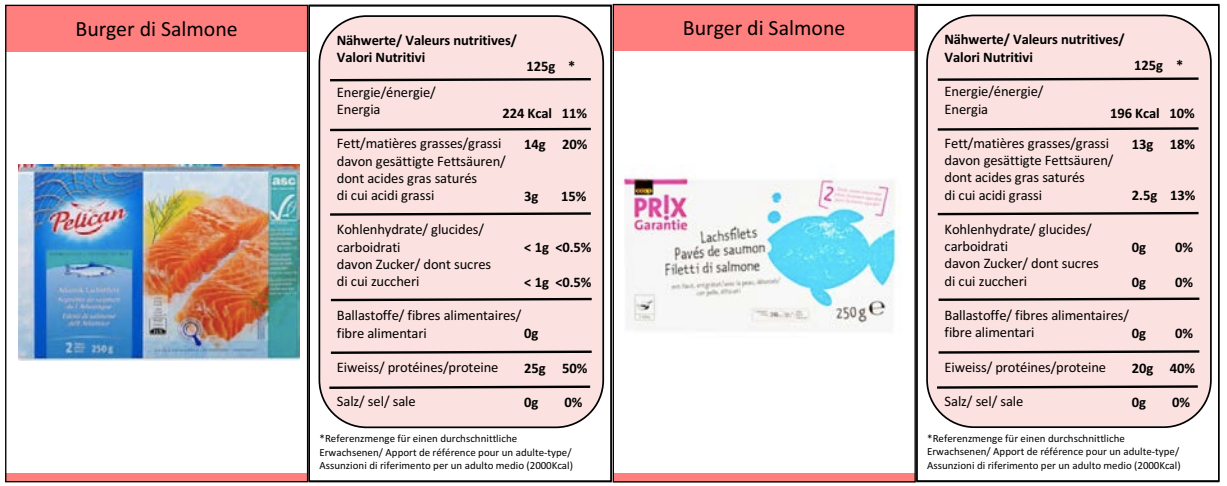

Fig. 44 Burger Debate, nutritional fact cards

Fig. 45 Burger Debate, nutritional fact cards

Fig. 46 Burger Debate, nutritional fact cards

Fig. 47 Burger Debate, nutritional fact cards

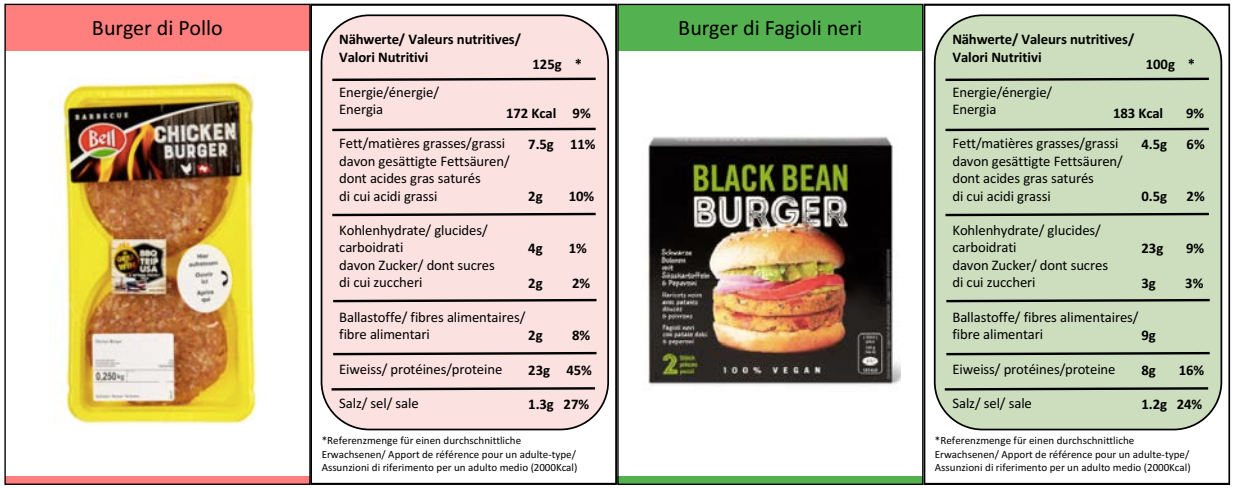

Fig. 48 Burger Debate, nutritional fact cards

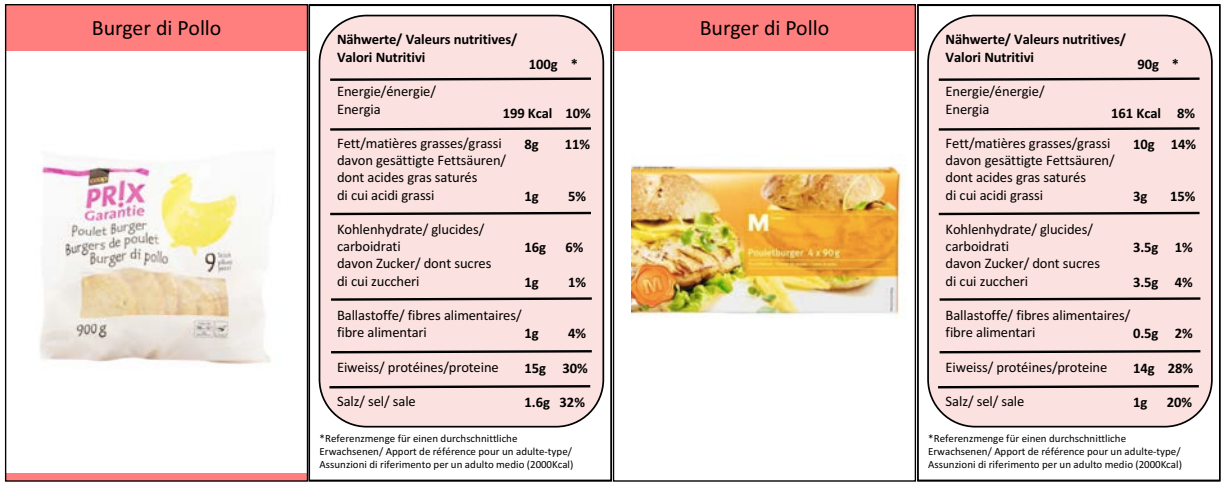

Fig. 49 Burger Debate, nutritional fact cards

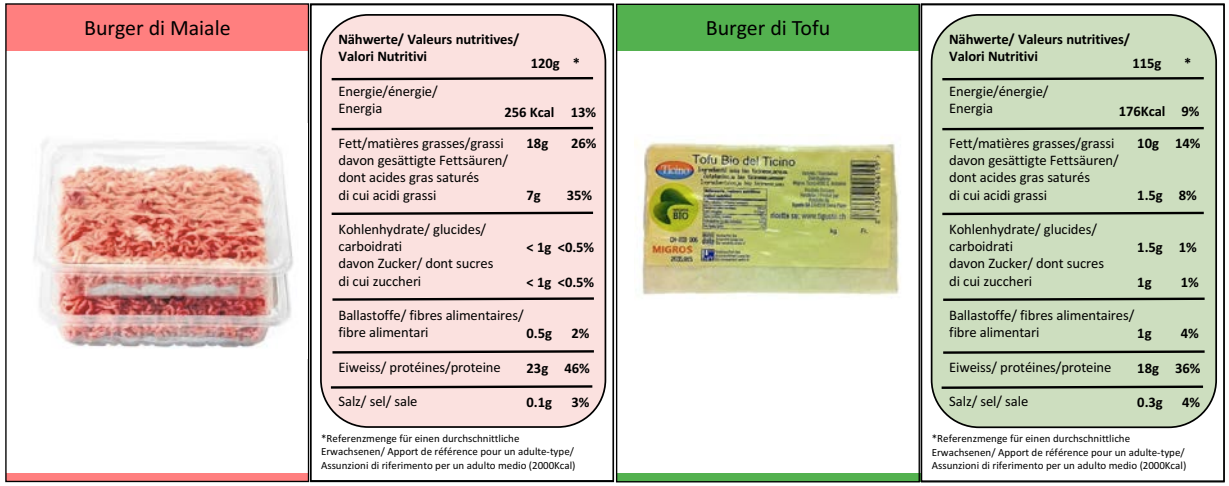

Fig. 50 Burger Debate, nutritional fact cards

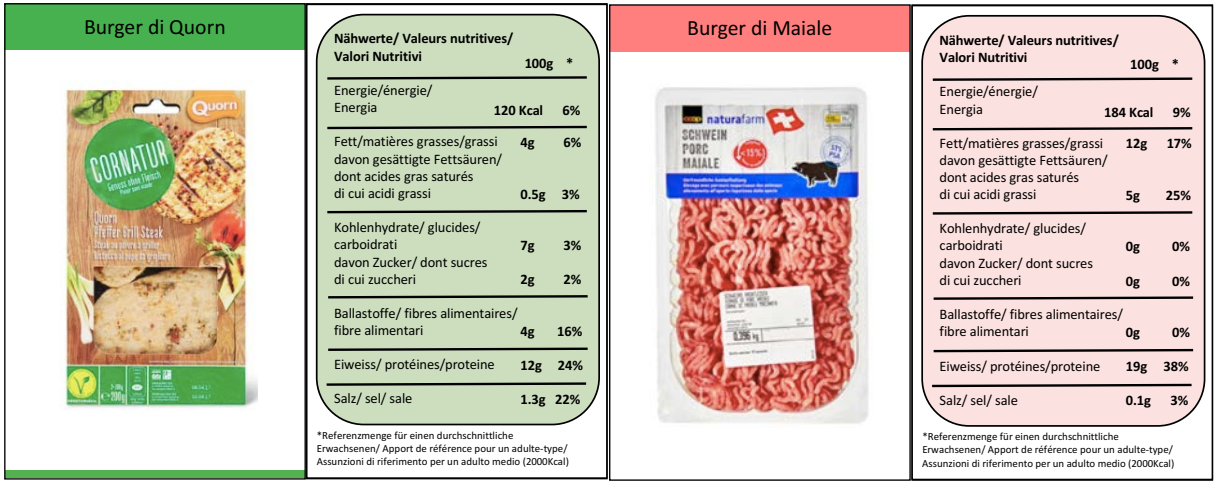

Fig. 51 Burger Debate, nutritional fact cards

Fig. 52 Burger Debate, nutritional fact cards

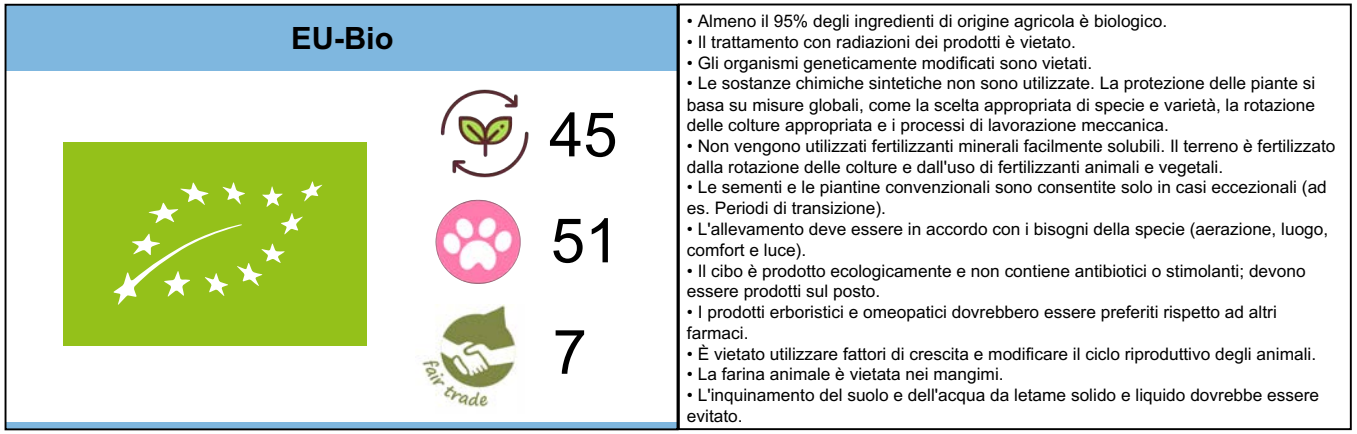

Fig. 53 Label meaning cards

Gemma Bio e Gemma Bio Suisse	
BIO BIOSUISSE 82 75 62	• Almeno il 90% delle materie prime proviene dalla Svizzera. • La produzione deve essere biologica in tutta la fattoria e la diversità naturale deve essere rispettata. • L'allevamento e l'alimentazione devono essere conformi ai bisogni della specie (principalmente con alimenti biologici). • L'uso di OGM è proibito. • I pesticidi e i fertilizzanti sintetici devono essere abbandonati. • Gli additivi non necessari, come aroma e colorante, devono essere dispensati. • Ogni azienda deve adottare almeno 12 misure per promuovere la biodiversità. Esempi: manutenzione di siepi, bordi forestali, muri a secco, apicoltura, ecc. • Al posto dei concimi chimici sono utilizzati concimi come letame o composto che favoriscono la fertilità del suolo. • Stalle spaziose, uscita regolare all'aperto e allevamenti di pollame più piccoli garantiscono il benessere degli animali. • In caso di malattia, gli animali Gemma Bio sono curati con la medicina complementare. L'impiego pro lattico di antibiotici è vietato.
Naturaplan (Coop)	
naturaplan BIO 82 75 95	• La produzione deve essere biologica in tutta la fattoria e la diversità naturale deve essere rispettata. • L'allevamento e l'alimentazione devono essere conformi ai bisogni della specie (principalmente alimenti biologici). • L'uso di OGM è proibito. • I pesticidi e i fertilizzanti sintetici devono essere abbandonati. • I prodotti alimentari devono essere trattati con cura. • Gli additivi non necessari, come aroma e colorante, devono essere dispensati.

Fig. 54 Label meaning cards

IP-Suisse   57  65	• Le prestazioni ecologiche richieste dall'ordinanza federale sui pagamenti diretti sono fornite nell'intera azienda. • La produzione e la lavorazione avvengono esclusivamente in Svizzera (incluso il Principato del Lichtenstein, nella zona franca attorno a Ginevra e nelle aree di confine governate da una convenzione internazionale). • Le condizioni minime di proprietà degli animali da allevamento devono essere rispettate. • Qualsiasi processo di selezione o agente di produzione che utilizza l'ingegneria genetica è proibito (produzione animale e vegetale). • I semi di soia utilizzati per i foraggi e altri prodotti di origine animale sono prodotti in modo sostenibile. • L'uso di fertilizzanti chimici sintetici e prodotti fitosanitari è limitato o proibito.
Migros Bio   70  75  75	• Produzione biologica nell'intera azienda • Almeno il 95% degli ingredienti dei prodotti trasformati deve provenire da agricoltura biologica, in conformità con le specifiche di Bio-Suisse. • La produzione agricola deve essere naturale e sostenibile, operare a ciclo chiuso e utilizzare processi naturali. • Il trasporto aereo e gli organismi geneticamente modificati sono vietati. • Sono vietati i prodotti fitosanitari sintetici chimici, i fertilizzanti minerali facilmente solubili e i fertilizzanti sintetici azotati. • I prodotti a base di erbe sono coltivati in terreno naturale e sano, non in coltivazione fuori suolo (substrato artificiale). • Gli animali dovrebbero essere in grado di uscire regolarmente all'aperto e di essere nutriti per lo più di alimenti biologici. • Carne, latte e uova provengono esclusivamente da aziende agricole Bio Suisse.

Fig. 55 Label meaning cards

TerraSuisse (Migros)	
  57  65	I prodotti con etichetta Terra Suisse sono conformi alle linee guida IP-Svizzera: • Le prestazioni ecologiche richieste dall'ordinanza federale sui pagamenti diretti sono fornite nell'intera azienda. • La produzione e la trasformazione avvengono esclusivamente in Svizzera (incluso il Principato del Liechtenstein, nella zona franca che circonda Ginevra e nelle aree di confine disciplinate dalla legislazione federale o da una convenzione internazionale). • Le condizioni minime di proprietà degli animali da allevamento devono essere rispettate. • Qualsiasi processo di selezione o agente di produzione che utilizza l'ingegneria genetica è proibito (produzione animale e vegetale). • I semi di soia utilizzati per i foraggi e altri prodotti di origine animale sono prodotti in modo sostenibile. • L'uso di fertilizzanti chimici sintetici e prodotti fitosanitari è limitato o proibito.
Naturafarm (Coop)	
naturafarm  39  68	• L'allevamento, l'ingrasso, la macellazione e la lavorazione devono essere effettuati in Svizzera. • Le operazioni devono fornire i benefici verdi richiesti, in conformità con l'ordinanza federale corrispondente. • Gli animali hanno uno spazio sufficiente, in conformità con le disposizioni federali per sistemi di stabulazione particolarmente adatti agli animali (STS) e regolari uscite all'aperto (SRPA). • Le zone notte sono coperte di paglia. • Non è possibile utilizzare mangimi geneticamente modificati. • Nei prodotti trasformati (salumi), l'uso di additivi deve essere evitato il più possibile. Sono ammessi solo quelli indicati nell'ordinanza svizzera sull'agricoltura biologica.

Fig. 56 Label meaning cards

Aquaculture Stewardship Council   77	• Il cibo non contiene specie di pesci a rischio critico. Le operazioni certificate ASC utilizzano solo farina di pesce e olio di pesce da fonti responsabili. • La quantità di fauna selvatica consentita nella dieta è regolata. • I farmaci profilattici sono proibiti. Sono consentite solo le sostanze chimiche prescritte da specialisti riconosciuti. Tutti gli allevamenti ittici devono avere livelli di ossigeno disciolto diurno inferiori al 65%. Pertanto, l'attività biologica giornaliera, la quantità di pesce per metro cubo, è limitata. • Durante la fase di crescita (dall'alveare alla pesca), il tasso di mortalità del pangasio non deve superare il 20%. • Gli allevamenti ittici devono adottare misure per impedire ai pesci d'allevamento di mescolarsi con la fauna locale. • Una fattoria pangasica a circuito chiuso deve utilizzare un massimo di 5000 metri cubi di acqua per tonnellata di pesce prodotto.
Marine Stewardship Council   66	• La pesca non dovrebbe portare a uno sfruttamento eccessivo e la sopravvivenza delle specie non dovrebbe essere messa in pericolo (la pesca di esplosivi e il veleno sono proibiti e le catture accidentali dovrebbero essere evitate). • La struttura, la produttività, la funzione e la diversità dell'ambiente marino (ecosistema) sono alla base della pesca e devono essere mantenute. • I sistemi di gestione garantiscono che le attività rispettino i principi della pesca sostenibile e riducano al minimo il loro impatto sull'ambiente marino. • La legislazione e le norme locali, nazionali e internazionali sono rispettate. • I diritti e gli interessi a lungo termine delle popolazioni dipendenti dalla pesca sono mantenuti. • La linea di tracciabilità garantisce il rispetto dei requisiti per tutte le fasi della produzione e della lavorazione.

Fig. 57 Label meaning cards

Table 12 General carbon footprint of burger ingredients

Food item	**CF Production** *(g CO_2-eq/g food)*	**CF Processing** *(g CO_2-eq/g food)*	**Total CF** *(g CO_2-eq/g food)*	**References**
Beef	24	3	27	(Clune et al., 2017; Eshel et al., 2014; Nijdam et al., 2012, 2012; Notarnicola et al., 2017; Ray Jacobsen, Valerie Vandermeulen, 2014; Vainio et al., 2016)
Pork	8	4	12	(Clune et al., 2017; Eshel et al., 2014; Nijdam et al., 2012, 2012; Notarnicola et al., 2017)
Chicken	4	3	7	(Clune et al., 2017; Eshel et al., 2014; Nijdam et al., 2012, 2012; Notarnicola et al., 2017)
Salmon	9	3	12	(BC SALMON FARMERS ASSOCIATION, 2016; Clune et al., 2017; Nijdam et al., 2012, 2012; Pelletier et al, 2009; Scarborough et al., 2014; Weber & Matthews, 2008)
Soy/tofu	0.5	2	2.5	(Mejia et al., 2017; Smetana et al., 2015; Vainio et al., 2016)
Quorn		6.5	6.5	(Smetana et al., 2015; T J A Finnigan, 2010)
Beans	0.5	1.5	2	(Sim et al., 2007; Tobler et al., 2011b; Vainio et al., 2016)
Cheese	12	2	14	(Clune et al., 2017; Jennie I Macdiarmid, Janet Kyle, Graham W Horgan, Jennifer Loe, Claire Fyfe, Alexandra Johnstone, 2012; Jungbluth et al., 2017; Lindenthal et al., 2010; Nemecek et al., 2011; Notarnicola et al., 2017; Stoll-Kleemann & O'Riordan, 2015; Temme et al., 2013; Tesco, 2012)
Bread	0.3	0.7	1	(Braschkat, Patyk, Quirin, & Reinhardt, 2003; Ag, 2016; Notarnicola, Tassielli, Renzulli, & Monforti, 2015)
Tomatoes	0.5	0.5	1	(Boulard et al., 2011; Payen et al., 2015; Tesco, 2012; Tobler et al., 2011b)
Tomatoes Greenhouse	2.5	0.5	3	(Boulard et al., 2011; Payen et al., 2015; Tesco, 2012; Tobler et al., 2011b)
Lettuce	0.5	0.5	1	(Clune et al., 2017; Halberg, 2008; Hospido et al., 2009; Lindenthal et al., 2010; Stoessel et al., 2012; Tesco, 2012)
Lettuce Greenhouse	2.5	0.5	3	(Clune et al., 2017; Halberg, 2008; Hospido et al., 2009; Lindenthal et al., 2010; Stoessel et al., 2012; Tesco, 2012)

Table 13 Game data

Food item	Price CHF.-	Amount g	Price/kg	Producer profit 10% CHF.-	Producer profit/kg CHF.-	CF gCO_2-eq/g food	TOT CF production gCO_2-eq/ food	Organic	CF gCO_2-eq/g food	TOT CF processing gCO_2-eq/ food	Km	CF Transport gCO_2/kg food km	Transport means	CF Transport gCO_2	Total gCO_2-eq
Beef Burger Qualité&Prix CH	4.25	2x100g	21.25	0.43	2.13	24	4’800	same	3.00	600	300	0.062	Truck	4	5’404
Beef Burger Naturafarm CH	6.95	4x70g	24.82	0.70	2.48	24	6’720	same	3.00	840	300	0.062	Truck	5	7’565
Beef Burger Naturaplan organic CH	5.70	2x100g	28.50	0.57	2.85	24	4’800	same	3.00	600	300	0.062	Truck	4	5’404
Beef Burger Budget CH	10.50	10x100g	10.50	1.05	1.05	24	24’000	same	3.00	3000	300	0.062	Truck	19	27’019
Beef Burger Terra Suisse CH	7.50	4x100g	18.75	0.75	1.88	24	9’600	same	3.00	1200	300	0.062	Truck	7	10’807
Beef Burger Bio organic CH	4.80	2x100g	24.00	0.48	2.40	24	4’800	same	3.00	600	300	0.062	Truck	4	5’404
Pork Burger Naturafarm (ground) CH	7.60	400g	19.00	0.76	1.90	8	3’200	same	4.00	1600	300	0.062	Truck	7	4’807
M Classic CH	6.50	350g	18.57	0.65	1.86	8	2’800	same	4.00	1400	300	0.062	Truck	6	4’206
Chicken Burger Budget (Brazil)	9.45	9x100g	10.50	0.95	1.05	4	3’600	same	3.00	2700	156	11.16	Boat +truck	168	6’468
Chicken Burger Bell CH	5.95	2x125g	23.80	0.60	2.38	4	1’000	same	3.00	750	300	0.062	Truck	5	1’755
Chicken Burger CH	5.20	4x90g	14.44	0.52	1.44	4	1’440	same	3.00	1080	300	0.062	Truck	7	2’527
Salmon burger Naturaplan Scotland	13.65	2x125g	54.60	1.37	5.46	9	2’250	same	3.00	750	1800	0.062	Truck	28	3’028
Salmon Budget Faroe Island	4.80	2x125g	19.20	0.48	1.92	9	2’250	same	3.00	750	2600	0.062	Truck	40	3’040
Salmon MSC Ireland	9.95	2x100g	39.80	1.00	3.98	9	1’800	same	3.00	600	1800	0.062	Truck	22	2’422
Salmon burger ASC Ireland	7.90	2x125g	31.60	0.79	3.16	9	2’250	same	3.00	750	1800	0.062	Truck	28	3’028
Tofu Organic Suisse	4.50	2x125g	18.00	0.45	1.80	0.5	125	same	2.00	500	300	0.062	Truck	5	630
Tofu Organic Almanatura EU	3.30	2x200g	8.25	0.33	0.83	0.5	200	same	2.00	800	900	0.062	Truck	22	1’022
Quorn Burger EU	5.50	2x100g	27.50	0.55	2.75	6	1’200	same	0.00	0	900	0.062	Truck	11	1’211
Beans Burger CHINA	3.60	2x100g	18.00	0.36	1.80	0.5	100	same	1.50	300	47	2.48	Boat +truck	49	449
Cheese slides CH	2.50	10x20g	12.50	0.25	1.25	12	2’400	same	2.00	400	300	0.062	Truck	4	2’804
Cheese slides budget CH	2.80	20x20g	7.00	0.28	0.70	12	4’800	same	2.00	800	300	0.062	Truck	7	5’607
Bread buns USA	1.90	6x57g	5.56	0.19	0.56	0.3	103	same	0.70	239	47	4.2408	Boat +truck	51	393
Bread buns American IP-Suisse	2.90	6x50g	9.67	0.29	0.97	0.3	90	same	0.70	210	300	0.062	Truck	6	306
Tomatoes classic Spain	4.95	500g	9.90	0.50	0.99	0.5	250	same	0.50	250	1200	0.062	Truck	37	537
Tomatoes Naturaplan Spain	2.95	250g	11.80	0.30	1.18	0.5	125	-20%	0.50	125	1200	0.062	Truck	19	269
Tomatoes Organic Italy	3.75	300g	12.50	0.38	1.25	0.5	150	-20%	0.50	150	850	0.062	Truck	16	316
Tomatoes Primagusto CH	4.70	350g	13.43	0.47	1.34	0.5	175	same	0.50	175	300	0.062	Truck	7	357
Tomatoes classic Spain out season	4.95	500g	9.90	0.50	0.99	2.5	1’250	same	0.50	250	1200	0.062	Truck	37	1’537
Tomatoes Naturaplan Spain out season	2.95	250g	11.80	0.30	1.18	2.5	625	-20%	0.50	125	1200	0.062	Truck	19	768
Tomatoes Organic Italy out season	3.75	300g	12.50	0.38	1.25	2.5	750	-20%	0.50	150	850	0.062	Truck	16	915
Tomatoes Primagusto CH out season	4.70	350g	13.43	0.47	1.34	2.5	875	same	0.50	175	300	0.062	Truck	7	1’057
Lettuce Zurich	2.95	250g	11.80	0.30	1.18	0.5	125	same	0.50	125	30	0.062	Truck	0	250
Lettuce Naturaplan CH	2.95	250g	11.80	0.30	1.18	0.5	125	-13%	0.50	125	300	0.062	Truck	5	255
Lettuce France	2.30	250g	9.20	0.23	0.92	0.5	125	same	0.50	125	650	0.062	Truck	10	260
Lettuce Zurich out season	2.95	250g	11.80	0.30	1.18	2.5	625	same	0.50	125	30	0.062	Truck	0	750
Lettuce Naturaplan CH out season	2.95	250g	11.80	0.30	1.18	2.5	625	-13%	0.50	125	300	0.062	Truck	5	754
Lettuce France out season	2.30	250g	9.20	0.23	0.92	2.5	625	same	0.50	125	650	0.062	Truck	10	760

QUIZ (pro Frage können mehrere Antworten ausgewählt werden)

1) Wann denkst du ist Essen nachhaltiger?
- a) Weniger fettige Lebensmittel essen
- b) Lebensmittel wählen die lokal und saisonal sind ✓
- c) Ungekochte Lebensmittel vermeiden
- d) Dein Lieblingsessen wählen
- e) Weniger tierische Produkte (Fleisch, Eier, Käse, Milchprodukte) wählen ✓

2) Welche der nachfolgend genannten Punkte beeinflusst die Nachhaltigkeit von Lebensmittel nicht?
- a) **Wo es produziert wird**
- b) **Wie es produziert wurde**
- c) **Wie es transportiert wird**
- d) **Wie teuer es ist** ✓

3) Was bedeutet es, wenn ein Lebensmittel einen grossen Umwelteinfluss hat?
- a) **Es ist sehr teuer**
- b) **Für die Produktion werden vielen Ressourcen benötigt** ✓
- c) **Es ist ein gesundes Lebensmittel**
- d) **Die Produktion hat einen negativen Einfluss auf unser Ökosystem (Verschmutzung)** ✓

4) Die Art des Lebensmittels (Gemüse, Fleisch etc.) hat keinen Einfluss auf die Nachhaltigkeit, nur der Transport beeinflusst die Nachhaltigkeit.
- a) **richtig**
- b) **falsch** ✓

5) Was heisst es, wenn auf einem Lebensmittel Label „bio“ steht?
- a) **Es beinhaltet keine genetisch modifizierten Organismen** ✓
- b) **Es wurde mit den bestmöglichen nachhaltigen Landwirtschaftsmethoden produziert** ✓
- c) **Es ist frei von Antibiotika, Wachstumshormonen und Pestiziden**✓
- d) **Es wurde lokal produziert**

6) Welche der folgenden Punkte ist bei Lebensmitteln verantwortlich für die grössten Treibhausgasemissionen?
- a) **Produktion** ✓
- b) **Verarbeitung**
- c) **Transport**
- d) **Kochen**

7) Welcher der folgenden Burger ist umweltfreundlich?
- a) **Biologischer Rinds Burger aus der Schweiz**
- b) **Biologischer Lachs Burger aus Europa**
- c) **Bohnen Burger aus China** ✓

8) Wann sind Tomaten saisonal in der Schweiz?
- a) **Frühjahr** ✓
- b) **Sommer** ✓
- c) **Herbst** ✓
- **d) Winter**

9) Welche der folgenden Punkte hilft zu messen, wie nachhaltig etwas ist?
- a) **CO_2-Fingerabdruck**
- b) **CO_2-Fussabdruck** ✓
- c) **Energie Fussabdruck**
- d) **Energie Index**

10) Ist Käse aus der Schweiz umweltfreundlicher als Poulet aus Brasilien?
- a) **Richtig**
- b) **Falsch** ✓

Fig. 58 Quiz I (German)

QUIZ
More than one answer it is possible

1 **What do you think is eating more sustainable?**
☐ Avoid fatty food
☐ Choose food that is local and seasonal✓
☐ Avoid cooked food
☐ choose your favourite food
☐ Eat less animal products ✓

2 **What is the meaning that a food has a big environmental impact?**
☐ It is very expensive
☐ For its production, there is a big use of natural resources ✓
☐ It is a healthy food
☐ Its production has a negative impact on our ecosystem (pollution) ✓

3 **The type of food makes no difference in terms of sustainability, only the transport counts.**
☐ True
☐ False✓

4 **If a food label says organic, what does it mean?**
☐ It contains no genetically modified organism ✓
☐ It was produced using the best sustainable agricultural methods ✓
☐ It is free of antibiotic, growth hormones and pesticides ✓
☐ It is locally produced

5 **Which of the following stages of the food chain, generally accounts for the largest portion of GHG emissions?**
☐ Production ✓
☐ Processing
☐ Transportation
☐ Cooking

6 **Which of the following burger is the eco-friendliest?**
☐ Organic beef burger from Switzerland
☐ Organic Salmon burger from Europe
☐ Beans burger from China ✓

7 **Which of the following meal is the environmental-friendliest?**


☐ fish


☐ chicken ✓


☐ pork

8 **Which of these indicator is used to measure the amount of GHG emissions?**
☐ Ecological footprint
☐ Carbon footprint ✓
☐ Energy index

9 **Which of the following meal is the environmental-friendliest?**


☐ Veggie burger ✓


☐ Salmon


☐ Pasta with tomatoes sauce✓


☐ beef steak

10 **Is environmental friendliness a criterion that you take in consideration for evaluating your food choices?**
☐ Yes
☐ No

Fig. 59 Quiz II (Translated)

GAME EVALUATION SHEET

Rate these on a continuum; circle one number in each area:

Complexity:

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
very simple average very complex

Game Instructions/Rules:

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
very simple average very complex

Uniqueness (How different was this game from other games?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
not much different – very different

Playing time (Was the game too short, too long or, just right?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
too short just right too long

Game Idea (Concept) or Theme:

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
boring or weak OK brilliant

Interest (How much did you like this game?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
hated it it was OK loved it

Repeat Play (How often will you play this game?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
never again once a lot

Waiting time with nothing to do (How much waiting between your turns?):

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
very little normal amount too much

Game board size: Was the game board too small, too big, or just the right size?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
too small just right too big

Text size: Was the text on the board, cards or instructions too small or, just right?

0 – 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10
too small just right too big

Do you have any specific complaints, or precise suggestions that you feel would make the game better?

Fig. 60 Liking form

Declaration of Originality

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

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I hereby confirm that I am the sole author of the written work here enclosed and that I have compiled it in my own words. Parts excepted are corrections of form and content by the supervisor.

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