

Fill your belly not your bin

An action research project to reduce food waste at
Kunskapsskolan in Trelleborg, Sweden

Gyeong Jeong Min & Silvia Mugnaini

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Abstract

School canteens have been identified as a unique case to address food waste due to their dual role: on one hand as big generators of food waste and on the other as settings to deliver education to reduce it. This thesis applies action research methodology to a collaborative project with a school called Kunskapsskolan in Trelleborg, Sweden, attempting to reduce food waste. The aim is to identify drivers of food waste and by applying the Three Spheres of Transformation framework explore possibilities and constraints to reduce food waste in the school. Results show that food waste drivers can be categorized as behavioral, operational and situational which are interconnected with possibilities in the personal and practical spheres and with constraints mainly in the political. This thesis concludes that all three spheres, the personal, political and practical spheres, should be considered in order to significantly reduce food waste in the school canteen.

Keywords: food waste, school canteens, sustainability education, Three Spheres of Transformation framework, mixed methodology, Kunskapsskolan in Trelleborg

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1. Introduction

1.1 Problem definition

Annually, up to one-third of the global food production for human consumption is estimated to be wasted (Derqui et al., 2018; García-Herrero et al., 2019). This amount of food waste is associated with a total carbon footprint of 4,4 Gt CO₂-eq per year (García-Herrero et al., 2019). Generally, food waste can be defined as edible food that is thrown away unnecessarily at any point of the food supply chain (FAO, 2011).

The production and consumption of food cause severe environmental problems in terms of land and freshwater use, eutrophication, and biodiversity loss (Ritchie & Roser, 2020). This contributes to 20-25 percent of the total climate impact in Sweden (Westö & Jensen, 2018). Food produced but not consumed represents a mismanagement of natural resources (Engström & Carlsson-Kanyama, 2004). Therefore, reducing avoidable food waste is considered a priority both in Sweden and internationally (Westö & Jensen, 2018). To address the food waste issue, the UN Sustainable Development Goals (SDG 12.3) has set specific targets to cut 50% per capita food waste at the retail and consumer level by 2030 (García-Herrero et al., 2019; Kasavan *et al.*, 2021). Moreover, the European Parliament and Council Directive 2018/851 called on member states to take action to monitor and reduce food waste (Boschini et al., 2020).

In developed countries, food waste occurs predominantly at the consumption stage of the supply chain, (Derqui et al., 2018; García-Herrero et al., 2019; Kasavan et al., 2021) and it is mostly due to behavioral issues (Boschini et al., 2020). In Europe, almost 42% of food waste is produced at the consumption level (Kasavan et al., 2021). In Sweden, food waste per person amounted to 129 kilogrammes in 2016 (Westö & Jensen, 2018).

School canteens have been identified as big generators of food waste (Derqui et al., 2018; Kasavan *et al.*, 2021). In 2019, the Swedish National Food Agency conducted a survey about national food waste in schools and preschools. It shows that 60-70 grams of food waste per diner has been thrown away, including kitchen, serving, and plate food waste (*Livsmedelsverket*, n.d.-b). It has been estimated that schools have the potential to lower their waste by 50% with great environmental benefits (Eriksson et al., 2017). Therefore, it is crucial to take action to reduce food waste at school level in Sweden.

Scholars have highlighted individual choices as the most relevant factor for food waste generation (Derqui et al., 2018). On the other hand, scholars have determined possibilities to modify behaviors by increasing awareness through school education (Derqui et al., 2018). Since food links nature,

human survival, health, culture, and livelihood in our society, it has the potential to generate substantial learning (Kerton & Sinclair, 2010). In this case, schools, which are one of the main sources of the problem, represent an ideal scenario to deliver education as well as improve food habits (Derqui et al., 2018; García-Herrero et al., 2019; Lagorio et al., 2018). Specifically, the Swedish National Food Agency suggests using the school lunch as an educational tool to provide students with knowledge about a sustainable lifestyle and reduce food waste (*Livsmedelsverket*, n.d.-a).

1.2 Research aim and research questions

This thesis represents the final component of a collaborative project with Kunskapsskolan in Trelleborg in Sweden, a school with students from 4th to 9th grade (Kunskapsskolan, n.d.). The project started due to the school's interest in engaging students in sustainability issues. Our collaboration attempted to reduce plate food waste in the school canteen by using the school lunch as an educational tool.

The purpose of this thesis is to identify the drivers of food waste and explore possibilities and constraints to reduce food waste in the school. The project has been developed in collaboration with stakeholders from the school -a group of students and a teacher- following action research methodology.

To meet our objectives, the research is guided by the following question and sub-questions:

How can a project to reduce food waste in the school canteen of Kunskapsskolan be designed?

- What are the factors that influence food waste generation in Kunskapsskolan according to stakeholders' perceptions?
- What are the possibilities and constraints to reduce food waste in Kunskapsskolan according to stakeholders' perceptions?

1.3 Contribution to sustainability science

Sustainability science has developed as an interdisciplinary field that seeks to understand the interaction between human activities and the environment (Kates et al., 2001). The objective of sustainability science is to find a way to support the transition toward sustainability (Clark, 2007). This thesis project contributes to sustainability science by attempting to empower students to think and act more sustainably towards food and food waste, thus supporting a transition towards more sustainable food habits. According to Spangenberg (2011), sustainability science has three characteristics based on different definitions. First, sustainability science should start from certain problems and pursue taking measures (Spangenberg, 2011). Second, sustainability science should present an integrated assessment that connects knowledge with action (Spangenberg, 2011). And

lastly, sustainability science should be interdisciplinary (Spangenberg, 2011). This thesis starts by identifying the drivers of the food waste problem and then explores possibilities and constraints to reduce food waste in the school canteen. The implemented measures include providing information about food waste, raising awareness and connecting it to actions. These measures fall under sustainability education since they aim to encourage students to think and act in a way to support sustainability transitions.

Barth & Michelsen (2013) point out how education contributes to sustainability science. They highlight three areas of contribution: 1) individual action and behavior change, 2) organizational change and social learning, and 3) inter- and transdisciplinary collaborations. First, education contributes to sustainability science by enabling long-term changes in the behavior of individuals (Barth & Michelsen, 2013). The role that individuals play in the process of transformation towards sustainability is acknowledged as a way to improve interaction between nature and society (Kates et al., 2001). The project aims to reduce food waste in the school by raising awareness and influencing behavior of the students through implementing different educational measures. Second, social learning, which is defined as learning in social settings, is a precondition to social action and therefore to transition to a more sustainable future (Barth & Michelsen, 2013). To support social learning for sustainable transition, a key aspect is the use of participatory methods in which the learner contributes to the entire process as an active participant (Barth & Michelsen, 2013). Kates et al. (2001) define participatory procedures as one of the research strategies that best suit sustainability science. Strong collaborative research processes in which researchers and stakeholders interact, starting from problem framing to strategy implementation, advance sustainability research projects by initiating transitions towards sustainability (Wiek et al., 2012). This thesis utilizes participatory methods through applying action research during the data collection. Lastly, education contributes to sustainability science by highlighting structures of learning in inter- and transdisciplinary settings (Barth & Michelsen, 2013). Inter- and transdisciplinary collaborations indicate mutual engagement and constant negotiations as key factors (Barth & Michelsen, 2013). This project had mutual engagements from the two authors of this thesis, one student from the same university program, and a teacher and a group of students from Kunskapsskolan in Trelleborg. Also, throughout the process all the decisions were made through discussions. In addition, the measures taken are interdisciplinary since they include earth science, nutritional science, and sustainability science.

1.4 Thesis outline

In the background chapter, different concepts of sustainability education and previous research on food waste in schools canteens are introduced. The third chapter includes the description of the

theoretical framework and how it is applied in this thesis. In the methodology chapter, the notion of action research is explained alongside action research steps through which data have been collected. Limitation of the research methods, research ethics, and reflection on co-writing are also included in the methodology chapter. Through the application of descriptive statistics and thematic analysis, the results chapter presents the findings of this thesis. The discussion chapter has been merged with the results to enhance the interpretation of the data and draw conclusions. In this chapter, suggestions for further research are explored as well. Lastly, the conclusion chapter includes a summary of main points and findings of this thesis. Materials produced within the case study can be found in appendices.

2. Background

2.1 Sustainability education

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), education is the most powerful path to sustainability (Buckler & Creech, 2014). At the 1992 United Nations Conference on Environment and Development (UNCED), 178 countries admitted the importance of Education for Sustainable Development and added it to Agenda 21 (Buckler & Creech, 2014). Agenda 21, especially chapter 36: 'Promoting Education, Public Awareness and Training', mentions that education is a key to foster sustainable development by helping people and societies to gain their capabilities (UNCED, 1992). Later, the United Nations General Assembly declared 2004-2015 the Decade of Education for Sustainable Development (Castro, 2015). Finally, in 2015, Education for Sustainable Development was embodied in Sustainable Development Goals Target 4.7 of the Agenda 2030. The target ensures that, by 2030, all students acquire the knowledge and skills needed to promote sustainable development (Mochizuki, 2016).

Education is essential for people to develop their abilities to address environmental issues, to raise awareness, value, and attitudes, and to improve skills and behavior that support sustainable development (UNCED, 1992). Education for Sustainable Development means including key sustainable development issues - such as sustainable consumption - in teaching and learning. It also requires participatory teaching and learning methods that motivate and empower learners to change their behaviors and take action for sustainable development (UNESCO, 2012). Education for Sustainable Development empowers people to change the way they think and work towards a sustainable future (UNESCO, 2020) through helping people develop knowledge, skills, values, and behaviors needed for sustainable development (UNESCO, 2020).

Education for Sustainable Development is an umbrella term for different pedagogical approaches to education in relation to sustainability. In particular, three main pedagogical approaches within

Education for Sustainable Development have been identified: Education *about*, *for*, and *as* Sustainability. The first approach, Education *about* Sustainability, focuses on transmitting sustainability as disciplinary content knowledge (O'Neil, 2018), developing awareness and understanding about human-environmental interactions (Tilbury, 1995). The second approach, Education *for* Sustainability, moves from learning about sustainability concepts into learning for change. Within Education *for* Sustainability, teaching is not only about transmitting knowledge but also about transferring skills and attitudes to act sustainably (O'Neil, 2018). The aim is to catalyze persistent change (O'Neil, 2018). Several authors have criticized Education *for* Sustainability for not achieving its purpose: transforming society (Schnitzler, 2019; Sipos et al., 2008). In fact, such a shift in the process of knowing and thinking is temporary because it does not align with our being in the world (O'Neil, 2018). Therefore, a third approach has been proposed: Education *as* Sustainability or Transformative Sustainability Education which suggests moving into a more relational and interconnected way of being in the world (O'Neil, 2018). It is characterized by an ontological shift of iterative becoming (O'Neil, 2018).

In this study, the concept of Transformative Sustainability Education was applied to set the direction of research. Specifically, O'Neil's (2018) approach of applying Transformative Sustainability Education to food pedagogy was used. O'Neil (2018) mentions food as an active material subject for transformative learning, not as a passive object to be studied. Following this approach, students not only learn about sustainability and food systems or gain skills for sustainability, but also experience interconnected relationships between human and non-human material that leads to perspective changes within them (O'Neil, 2018). This project attempts to bring changes in students' perspectives and behavior by helping them learn and experience sustainability around food.

2.2 Previous research on food waste in school canteens

Studies related to food waste in school canteens have been focusing on quantification of food waste (Byker et al., 2014; Derqui et al., 2018; Eriksson et al., 2017; Falasconi et al., 2015; García-Herrero et al., 2019) as well as on the environmental impact of food waste (Engström & Carlsson-Kanyama, 2004) with most of the environmental impacts of canteen meals derived from the presence of animal-based food categories (García-Herrero et al., 2019).

Other studies identified food waste drivers (Boschini et al., 2019; Derqui et al., 2018; Falasconi et al., 2015; Martins et al., 2020) including identification and quantification of risk factors for food waste generation (Steen et al., 2018). Previous research has also categorized the factors causing food waste. For instance, the UK's Waste and Resources Action Programme (2011) define them as behavioral, operational, and situational; Falasconi et al. (2015) uses avoidable unserved food, physiological

unserved food, and food served but not consumed. García-Herrero et al. (2019) divide food waste in: preparation waste, serving waste, and plate waste. Barriers to reduce school lunch plate waste were investigated by Zhao et al. (2019).

Further studies are suggested to explore interventions to prevent and reduce food waste (García-Herrero et al., 2019). Derqui et al. (2018) suggest that the feasibility and application of waste minimization interventions as well as the level of attractiveness of the initiatives should be researched. The study from Falasconi et al. (2015) recommends the need for further academic investigations into the different and interrelated dimensions of food waste including economic, environmental, nutritional, sociocultural, and technological aspects. Lagorio et al. (2018) underline the need to involve a wide range of stakeholders within projects to reduce food waste, which are important providers of resources. Steen et al. (2018) highlights the need to test and evaluate interventions with the potential to reduce certain risk factors.

Several studies related to food waste in school canteens underline that: 1) plate waste is usually the highest identified source of food waste in school canteens (Derqui et al., 2018; Engström & Carlsson-Kanyama, 2004; Falasconi et al., 2015). 2) Vegetables, legumes and bread disproportionately contribute to food waste (Falasconi et al., 2015; Derqui et al., 2018; Lagorio et al., 2018; Byker et al., 2014). 3) Schools that produce less food waste consider the canteen as part of the schools' pedagogical programme and not just as a fringe service and transmit awareness on the environmental and social impact of wasting food (Derqui et al., 2018).

3. Theoretical framework

This study adopts the Three Spheres of Transformation framework to identify possibilities and constraints to reduce food waste in Kunskapsskolan in Trelleborg.

The Three Spheres of Transformation is a framework that acknowledges and integrates different dimensions or "spheres" of transformation, emphasizing that processes of transformational change should involve all these dimensions (Bentz et al., 2019; O'Brien, 2018). The three spheres are practical, political, and personal spheres which represent interdependent measures that need to be implemented to reach a particular goal (Bentz et al., 2019). The spheres are represented as concentric and integrated into one another (Figure 1).

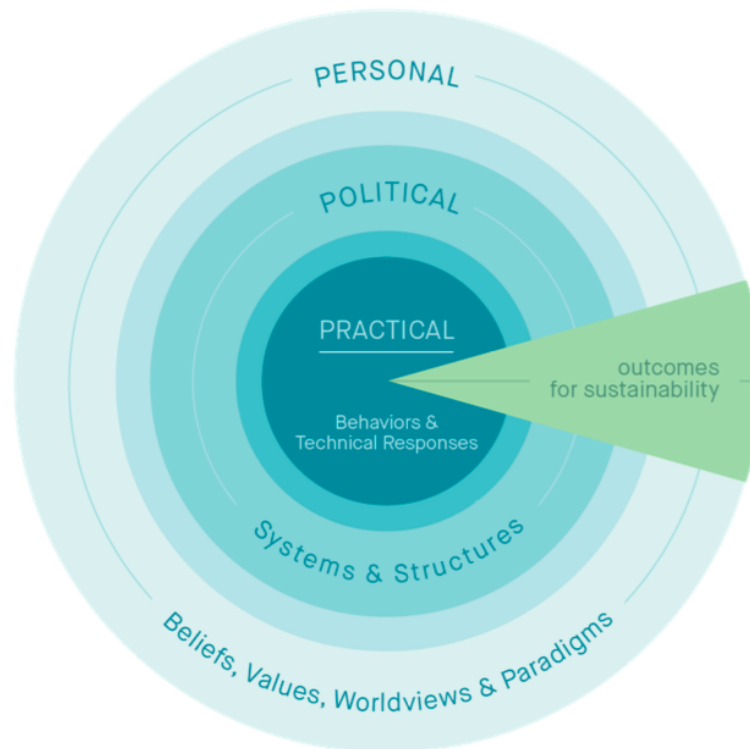


Figure 1. The Three Spheres of Transformation Framework. (O’Brien & Sygna, 2013).

The three spheres are described in detail below:

- Practical sphere: it represents the “outcome” sphere (O’Brien & Sygna, 2013). It includes solutions and changes in strategies, practices and behaviors (O’Brien & Sygna, 2013). Outcomes are observable and measurable in numbers, parameters, and indicators (O’Brien & Sygna, 2013). In the case of food waste in Kunska psskolan, the goal is to achieve zero food waste.
- Political sphere: it represents the systems and structures that define the constraints and facilitate possibilities to enable transformations in the practical sphere (O’Brien, 2018). It is in this sphere where both problems and solutions are identified and delimited (O’Brien & Sygna, 2013). Systems are defined as relationships between parts that form a bigger whole, while structures are described as the norms, rules, regulations, institutions, regimes, and incentives that influence how systems are designed, organized, and governed (O’Brien, 2018). Cooperation, collaborations, and compromise can be formed and lead to change (O’Brien, 2018). In our case, it is represented by conditions under which the students operate in the canteen.
- Personal sphere: it is where individual and collective beliefs, values, and worldviews lie. Views, beliefs, and values shape the ways that the systems and structures (political sphere)

are viewed and how people behave (O'Brien, 2018). It also dictates what type of solutions (in the practical sphere) are considered possible, based on levels of consciousness and perception of agency (O'Brien & Sygna, 2013). Collective beliefs, values, and worldviews are the most difficult to transform but they can be influenced through transformative education (O'Brien & Sygna, 2013). In the case of this thesis, it refers to sustainability values in relation to food and food waste from both school's employees and students.

The Three Spheres of Transformation can be used as a framework to examine how, why and where transformation towards sustainability can occur (O'Brien & Sygna, 2013). By integrating the spheres, it is possible to view multiple entry points for sustainability outcomes and reach radical transformations (O'Brien & Sygna, 2013). The Three Spheres framework shows that realizing sustainable goals in the practical sphere calls for changes of systems and structures in the political sphere which are often driven by individual and collective values and worldviews of the personal sphere (O'Brien & Sygna, 2013). Therefore, the Three Spheres of Transformation's framework presuppose that a comprehensive change is needed at the personal, practical and systemic level (O'Brien, 2018).

By identifying possibilities and constraints in the practical, political, and personal spheres, we attempt to show how food waste generation in Kunskapsskolan depends on pragmatic, systemic, and individual factors. Possibilities are especially emphasized in relation to the measures implemented during the project and their outcomes in the personal and practical sphere.

4. Methodology

4.1 Case study description

This thesis applies a case study methodology which focuses on a project with Kunskapsskolan in Trelleborg. Kunskapsskolan is a Swedish private school with students from 4th grade to 9th grade (age ca. 10-15) (Kunskapsskolan, n.d.) and consists of around 300 students (Key informant, personal communication, 4 May, 2021). It has 29 branch schools all over Sweden (Kunskapsskolan, n.d.). Kunskapsskolan in Trelleborg established a Sustainability Committee formed with students who want to be involved in sustainable actions within the school. Furthermore, the school is trying to earn the "Green School" (Grön Flagg) certification by the end of the school year, which is in June 2021 (Key informant, personal communication, Feb 2, 2021). To achieve this, the school has designed a "Climate Action Plan", which was developed from the Youth Empowerment Sustainability Summit that the school attended in New York in 2020 (Key informant, personal communication, Feb 2, 2021). This plan

includes three main sub-projects: 1) zero food waste, 2) recycling, reducing, and reusing, and 3) energy and water audit and saving (Key informant, personal communication, Feb 2, 2021). Our case study focuses on the first goal: zero food waste. The zero food waste project is a collaborative effort between the Education for Sustainability Team - composed by the authors of the thesis and another student from our university program - the Sustainability Committee, and the teacher responsible for the Sustainability Committee and the Climate Action Plan. The project has been carried out from November 2020 to the beginning of May 2021.

4.1.1 Scope

This thesis investigates the problem of food waste in the school canteen of Kunskapsskolan in Trelleborg. Boundaries have been drawn on students wasting food, which is named plate waste in the scientific literature, and is usually the highest identified source of food waste in school canteens (Derqui et al., 2018; Engström & Carlsson-Kanyama, 2004; Falasconi et al., 2015). Plate waste is defined as “food left in the plate by students in the canteen” and categorized as avoidable food waste (García-Herrero et al., 2019, p. 250). Drivers are identified within the timeframe of our case study as well as possibilities and constraints to reduce food waste in Kunskapsskolan.

4.2 Research design

This thesis applies action research, a participative and collaborative methodology (Clark et al., 2020). Specifically, we cooperated with stakeholders in Kunskapsskolan in Trelleborg by following the model proposed by Davis (2010). This model fits the purpose of this thesis since it was developed to implement education for sustainability and bring about changes in childhood settings (Davis, 2010). Davis’ model has 6 phases: 1) prepare, 2) create a shared vision, 3) select priority issues, 4) develop an action plan, 5) implement action plan, 6) celebrate, evaluate, and plan for the future (Davis, 2010). Clark et al. (2020) indicate that it is important to prioritize the flexibility of the action research process and encourage researchers to adjust it based on students, context, and data. Given the time frame of both the project and this thesis, the steps of the process were modified from Davis’s model as shown in Table 1.

Table 1. Project timeline. (Source: Based on Davis, 2010, and modified by the authors).

Action research steps	Methods for data collection	Stakeholders Involved	Timeline
Prepare	Unstructured interview with the key informant	School teacher	3 November 2020
	Supervised self-completion questionnaire in form of a survey on student's knowledge and action on the problem of food waste -Questionnaire A	16 students from 4th grade	2 December 2020
Create a shared vision and select priority issues	Unstructured group interview	5 Sustainability Committee students	12 February 2021
Develop an Action Plan	Semi-structured group interview	5 Sustainability Committee students	19 February 2021
	Unstructured interview with the key informant	School teacher	22 February 2021
	Unstructured group interview	15 Sustainability Committee students	5 March 2021
Implement Action Plan	Information campaign and food waste diary (supervised self-completion questionnaire in the form of diary -Questionnaire B)	4 th grade students, with average of 18 respondents per day	22-25 March 2021
	Vote on the lunch menu (self-completion questionnaire in the form of survey -Questionnaire C)	146 respondents from the whole school	19-29 March 2021
Evaluate	Supervised self-completion questionnaire on the impact of the information campaign and food waste diary -Questionnaire D	4 th grade students, 16 answers	9 April 2021
Plan for the future	Share the thesis	School teacher	After thesis discussion

4.3 Methods for data collection and sampling

In order to collect data, this thesis relies on a mixed methods approach that combines both quantitative and qualitative research strategies. Four self-completion questionnaires, three unstructured interviews with a key informant, and three group interviews were conducted. The sample is specified for each questionnaire and interview. Triangulation, a commonly used strategy for

using multiple methods or sources of data to address the same question (Leavy, 2017), is used as shown in Figure 2. Triangulation can help establish validity (Leavy, 2017) and greater confidence of findings (Bryman,2012).

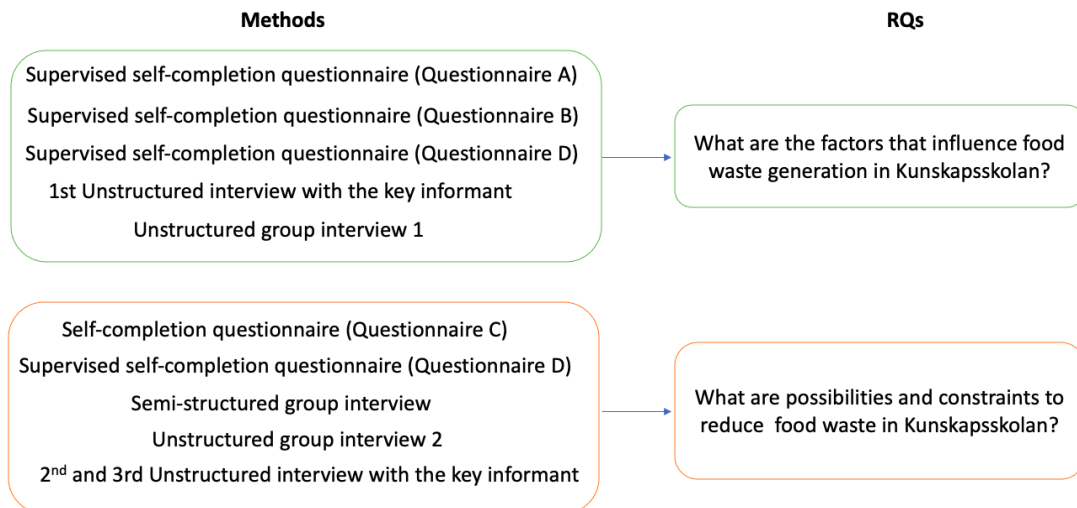


Figure 2. Triangulation of sources and associated research questions. (Own creation).

4.3.1 Questionnaires

First of all, four different *self-completion questionnaires* were used to collect data from the students. Three of them were supervised self-completion questionnaires, in which respondents answer the questionnaire in the presence of a researcher or someone responsible to supervise (Bryman, 2012). In this case, a mentor teacher, who is responsible for the knowledge development of a certain group of students (Kunskapsskolan, n.d.), was present with them and supervised their engagement.

- In this research, the first self-completion questionnaire (Questionnaire A) is in the form of a survey (see Appendix A) where we asked questions related to knowledge that students have in relation to different sustainability aspects of food on a 3-point frequency scale ranging from 'I know a lot' to "I don't know". Furthermore, students were asked how often they think about the aforementioned sustainability aspects of food and actions they do on a 5-point frequency scale ranging from "Very often" to "Never". Additionally, students were asked to rank the effect of certain activities on a 5-point frequency scale from "Very good" to "Very bad". The sample includes 16 students from 4th grade. The sample was suggested by our key informant since they are the mentor teacher of that class, the students were interested in the project, and the class could continue the action even after the project is completed (Key informant, personal communication, 22 Nov, 2020). The survey was in English.

- The second self-completion questionnaire was in the form of a food waste diary (Questionnaire B) (see Appendix C) which is part of the implemented strategies to increase students' awareness on food and food waste. First, we designed an information campaign about the food in the school lunch menu. The information campaign (see Appendix B) included carbon footprint, water footprint, nutritional benefits, and fun facts of the foods that were included in the school lunch menu of the day. The content of the information campaign was explained, from March 22nd to 25th, by a mentor teacher to the students during the morning assembly. After lunch, students filled in a diary in the class with the supervision of the mentor teacher. For this questionnaire, the sample was a 4th grade class with 18 students. The reasons for the sample are the same as for the first questionnaire. The material for the information campaign and food waste diary were in Swedish and students' answers were translated by the researchers.
- The third self-completion questionnaire (Questionnaire D) (see Appendix E) was designed to identify if awareness increased after the implementation of the information campaign and food waste diary. These questions were also designed to make students reflect about the implemented measures. Our sample included 16 students from 4th grade class since they participated in the activities. The questionnaire was formulated in Swedish and students' answers were translated by the researchers.

Another self-completion questionnaire in the form of a survey (Questionnaire C) (see Appendix D) was designed for the students to vote on the lunch menu as a part of the implemented measures. Additionally, it encouraged students to express ideas to reduce food waste in the school. The first part was used to corroborate findings related to food waste drivers while the second part provided additional information to investigate further possibilities and constraints for food waste reduction. Students were asked to vote on the lunch menu by themselves from March 19th to 29th. For this questionnaire, the sample was 146 students from different grades. The questionnaire was formulated in Swedish and students' answers were translated into English by the researchers.

4.3.2 Interviews

Another method used in this thesis is *unstructured interviews with a key informant*. An unstructured interview allows researchers to gain in-depth understandings on certain phenomena from the interviewees' perspectives (Zhang & Wildemuth, 2009). Key informants are experts that occupy a position of responsibility and influence in the community and are therefore able to provide information about what is going on around them (Marshall, 1996). In this case, the key informant is a school teacher who is responsible for the Sustainability Committee. Therefore, the key informant's

expertise was used to identify and understand the state of the problem of food waste in the school and possibilities and constraints influencing the applicability and impacts of implemented measures. As follow-ups to those interviews, emails were used to collect additional data from the key informant.

Finally, *group interviews* with the Sustainability Committee students were conducted. A group interview is a method of interviewing several participants on different topics with moderators (Bryman, 2012). The Sustainability Committee students were invited to participate in three group interviews due to their interest and involvement in sustainability issues and related activities in the school. The first interview was an unstructured group interview which was part of gathering information to understand and identify food waste drivers of the school. The second was a semi-structured group interview to determine possible solutions in the school from the students' perspectives, followed by a third and last unstructured group interview on selected strategies that appeared possible to be implemented within the project timeline. Guidelines for the semi-structured interview can be found in the Appendix F. 21 students were invited to join the group interviews and between 5 and 15 Sustainability Committee students participated for each interview.

All interviews were video calls through Zoom, held in English, and lasted between 30 to 45 minutes.

4.4 Methods for data analysis

In this thesis, two methods were used to analyze data. Questionnaire A and B have been analyzed through quantitative data analysis using descriptive statistics to calculate the frequency distribution of knowledge, thoughts, and actions related to food waste as well as the amount of waste generated. Descriptive statistics is a method that helps to describe a phenomenon in the data (Thompson, 2009). Additionally, thematic analysis has been selected as the method to analyze the unstructured interviews with the key informant, the group interviews, and Questionnaire C and D. Thematic analysis is a method to determine, evaluate, and describe themes within a qualitative data set (Braun & Clarke, 2006). It has been noticed that thematic analysis is a useful method for working within participatory research (Braun & Clarke, 2006) which makes this method for data analysis fitting in the context of this thesis. This thesis follows the six steps model of Braun & Clarke (2006) which is the most influential approach for doing thematic analysis in social science (Maguire & Delahunt, 2017). The steps are as follows: 1) Familiarizing with the data, 2) Generate codes, 3) Search, 4) Review themes and 5) Define themes and 6) Write up. The three themes identified are: food waste drivers, possibilities, and constraints to reduce food waste. For the latter, sub-themes have emerged in relation to personal, political, and practical spheres.

4.5 Limitations

Due to COVID-19, we could not be physically present in the school. For this reason, and due to language barriers, the implementation of the measures (information campaign and food waste diary) was delegated to the mentor teacher in the school. Moreover, not being able to follow students' engagement in the activities has affected the process of data collection for Questionnaire D for which some students appeared to have not fully understood the questions.

Another possible limitation of Questionnaire D could be that the respondents might not have been able to remember details of the measures since those were performed before the Easter break while the questionnaire was filled out after the break due to delays in the distribution of the questionnaire from the school. Furthermore, Questionnaire A entails students' self-assessment which might have been influenced by students' own biases.

Another limitation is that this research cannot be generalized due to the small samples and the use of purposive sampling. However, since Kunskapsskolan is spread all around Sweden, the study could be replicated in schools with similar characteristics.

Lastly, none of the interviews with the key informant or group interviews were recorded, due to the fact that the school's policy doesn't allow recording. Instead, notes were taken during the interviews which has the disadvantage of possibly missing not only what people say but also *the way* they say it during the interviews (Bryman, 2012).

4.6 Research ethics

According to Bryman (2012), the first ethical concern to consider is whether there is harm being done to the participants. Especially when dealing with young students, it is important to consider how the presence of research might affect them. Therefore, the first group interview with the Sustainability Committee students was held under the supervision of the key informant, after which the key informant gave us instructions on how to better moderate group interviews with the students. Moreover, the key informant was informed about the content of further interviews with the Sustainability Committee through email.

Because food waste is a sensitive topic, the information campaign was counterbalanced with different facts. On one hand, it provided knowledge on carbon and water footprint so that the students would understand the extent of the problem. On the other hand, it provided nutritional information since

plate waste negatively affects dietary intake. Additionally, fun facts were added so the information would not provoke feelings of anxiety and hopelessness. Moreover, concerns related to students with eating disorders were raised. However, the teacher has specified that it won't be a problem since they receive special care within the school, have a mentor to support them, and also have different menus.

Another aspect to consider in research ethics is whether there is a lack of informed consent (Bryman, 2012). Before starting any activities related to this thesis, we asked for approval through email to the key informant who approved the request.

Another point to take into account is whether there is an invasion of privacy (Bryman, 2012). Anonymity of respondents to the self-completion questionnaires as well as interviews was assured.

Lastly, we designed and used Questionnaire A previously for another academic course in the program. Therefore, precautions related to self-plagiarism were taken into account.

4.7 Reflection on co-writing

Reasons to establish the collaboration naturally arose due to personal interest and mutual engagement in the project and topic. We read academic literature individually, for example, Silvia focused on theoretical framework and Gyeong Jeong focused on methodology. After reading academic literature, we discussed the findings on Zoom and decided together which one to apply in this thesis. Based on these, we prepared and conducted questionnaires and interviews together. Data analysis was done together through Zoom as well. For writing, Silvia was initially responsible for 1.1 Problem definition, 1.2 Research aim and research questions, 2.1 Sustainability education, 2.2 Previous research on food waste in school canteens, 3. Theoretical framework, 4.4 Methods for data analysis, 4.6 Research ethics, 5.1 Factors that influence food waste generation, and 5.3 Last remarks and suggestions for further research. Gyeong Jeong was initially responsible for writing 1.3 Contribution to sustainability science, 4.1 Case study description, 4.2 Research design, 4.3 Methods for data collection and sampling, 4.5 Limitations, 4.7 Reflection on co-writing, 5.2 Possibilities and Constraints to reduce food waste at Kunskapsskolan in Trelleborg, and 6. Conclusion. Afterwards, we checked and revised each others' parts, so that we contributed equally and were mutually responsible for all the parts.

5. Results and discussion

5.1 Factors that influence food waste generation

Overall, the analysis of Questionnaire A and B, interviews with the key informant and group interviews with the Sustainability Committee have led to the identification of the following factors

(Table 2) that influence plate food waste generation in Kunskapsskolan in Trelleborg. Following the example of the UK's Waste and Resources Action Programme (2011), such factors can be grouped into three categories: 1) Behavioral drivers; 2) Operational drivers; and 3) Situational drivers. For each of these categories, evidence and discussion are provided in the sections below.

Table 2. Identified drivers of food waste at Kunskapsskolan. (Source: Based on UK Waste and Resources Action Programme, 2011, and modified by the authors).

Category	Identified drivers
Behavioral	Lack of environmental knowledge and awareness Social context Cultural, religious, and social norms
Operational	Menu composition Sensory characteristics of food Students serve themselves
Situational	Students' appetite Access and availability to buy food

5.1.1 Behavioral drivers

The first behavioral factor identified is *lack of environmental knowledge and awareness*. The results from Questionnaire A show that insufficient knowledge on food and food waste is a key factor influencing the attitude towards throwing away food. The level of students' knowledge was measured through questions on knowledge self-assessment. Results show that the majority of 4th grade students declared to have "little knowledge" about how food is produced (81,3%) and transported (56,3%) (Figure 3).

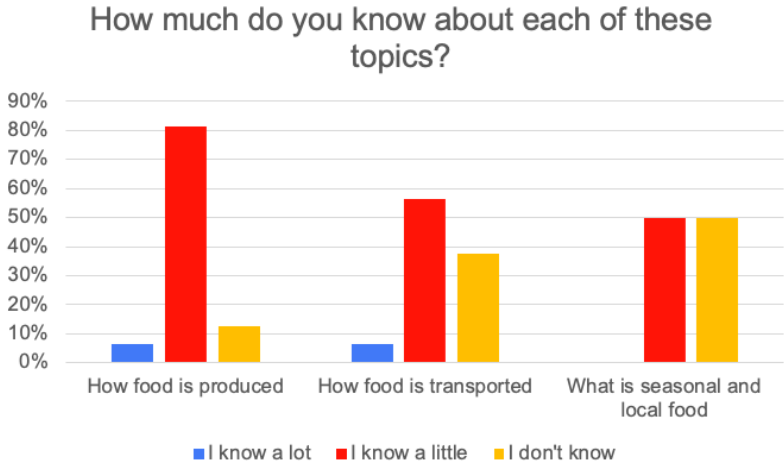


Figure 3. 4th graders stating, in Questionnaire A, knowledge about different food-related topics. (Own creation).

A partial lack of knowledge on these issues represents a factor that needs to be addressed when dealing with reducing food waste. In fact, when food is wasted, not only greenhouse gases are emitted by food waste itself but it is essential to consider also all the resources required to produce that food, for example, water and land, and to consider the emission from vehicles to transport it (Depta, 2018). Annually, the production and post-handling of food, that is later wasted, require around 30% of the world's agricultural area (FAO, 2013). Moreover, agricultural products for food that end up wasted necessitate a blue water footprint of 250 km³ (FAO, 2013). Although the agricultural stage has the biggest impact on the environment among all stages in the food supply chain, food consumption has a huge impact on the environment through the energy used for transportation, processing, packaging, and cooking (Steen et al., 2018). By preventing 1 kg of food waste, up to 29 kg of emitted CO₂ could be saved, depending on the type of food wasted (Steen et al., 2018). In addition, a 50% reduction in food wastage in developed countries is estimated to result in lowering the global water footprint by 59 Gm³ (Steen et al., 2018).

50% of 4th grade students also replied that they have "little knowledge" on seasonal and local food (Figure 3). Furthermore, students were asked to rank the effect of eating seasonal food and the majority of the students from 4th grade (62,5%) said it has "no effect". This can be read in relation to the fact that 50% of the students said they don't know about seasonal and local food. However, eating seasonal food has the benefit to reduce greenhouse gas emissions because it does not require the high-energy input from artificial heating or lighting needed to produce crops out of the natural growing season (Macdiarmid, 2014). On the other hand, while eating locally does not have significant impact on the environment since transport emissions are only 6% of food's total emissions globally (Ritchie & Roser, 2020), eating locally is important when we consider that 13,8% of food is lost along the supply chain (FAO, n.d).

Furthermore, students were asked how often they think about the aforementioned issues: how the food is produced, transported, and how often they think about the environment when purchasing food. Results are shown in Figure 4. 69% of 4th grade students affirm that they "rarely" think about how the food is produced while 56% "rarely" think about how the food is transported. Moreover, 50% of 4th grade students "sometimes" think about the environment when purchasing food. The lack of awareness on the environmental and socio-economic implications of food waste among students has also been suggested as a potential cause for food waste by Wilkie et al. (2015) and Painter et al. (2016).

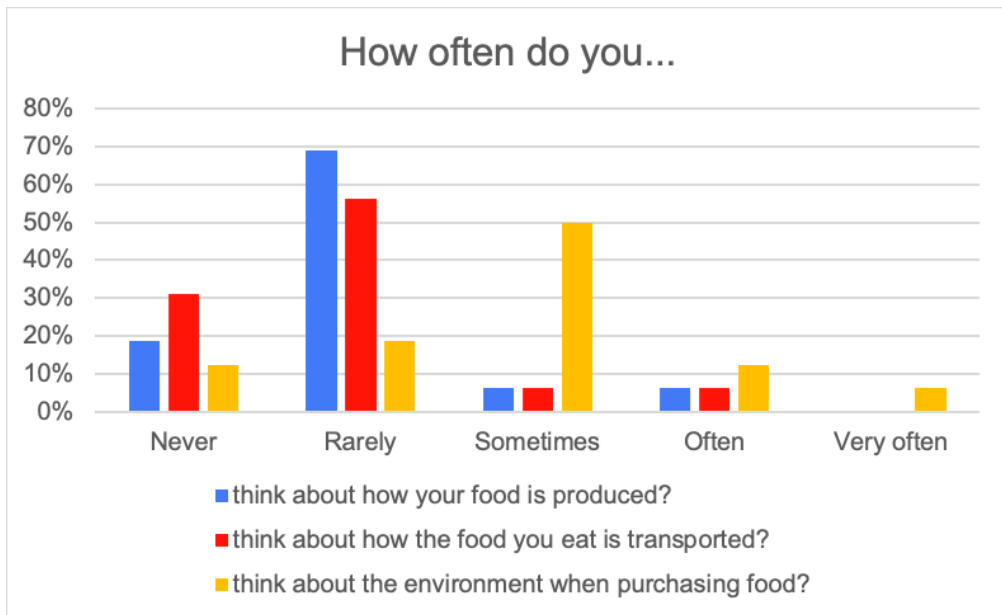


Figure 4. 4th grade students' thoughts, in Questionnaire A, on food related issues. (Own creation).

Results from Questionnaire A also show student's self-assessment on food related knowledge and thoughts and on the amount of food they throw away. The results show that 44% of students in 4th grade recognize that throwing away food is “bad” for the environment, 44% state that it is “very bad” while 6% say that it is “good” or that it “does not have an effect” for the environment (Figure 5).

IS THROWING AWAY FOOD GOOD OR BAD FOR THE ENVIRONMENT?

■ Very bad ■ Bad ■ No effect ■ Good ■ Very good

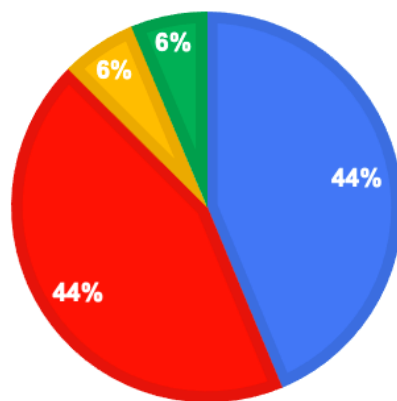


Figure 5. 4th graders ranking, in Questionnaire A, the impact of throwing away food. (Own creation).

Also, when students were asked if they threw away food, 50% of 4th graders stated “sometimes” and 43.8% indicated “rarely” while only 6% said “never” (Figure 6). It is significant to underline that even

if 44% of 4th graders rank throwing away food as “bad” (Figure 5), 50% of them indicate that they “sometimes” throw away food (Figure 6). A reason might be what Zhao et al. (2019) found out in their study where participants believed it was personally acceptable to throw away undesirable food and it was unacceptable to throw away wanted food.

HOW OFTEN DO YOU THROW AWAY FOOD?

■ Never ■ Rarely ■ Sometimes ■ Often ■ Very often

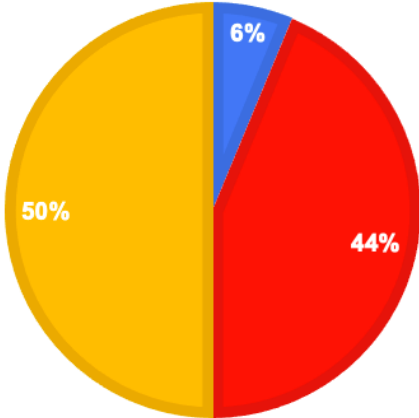


Figure 6. Students stating, in Questionnaire A, how often they throw away food they do not finish. (Own creation).

The *social context* also plays a role as a food waste driver. During the group interview with the Sustainability Committee, we were informed that if one student at the table tries the food and says it is disgusting then the others do not want to eat it either (Student 4a, Personal communication, Feb 12, 2021). The same participant said that some students just play with the food and they think it is funny to take it and then throw it away without even touching it (Student 4a, Personal communication, Feb 12, 2021). A study from Zhao et al. (2019) found social influence as a minor factor influencing food waste. In their study, some participants mentioned that they were unable to finish their food because they were distracted by peers (Zhao et al., 2019). Moreover, participants also commented that they finished their food when influenced to do so by their peers (Zhao et al., 2019). Further research is needed on the link between food waste generation in schools and peer pressure.

Differences in the amount of food thrown away are identified also based on *cultural, religious, and social norms*. One student affirmed during the group interview that certain students do not throw away food because of their cultural and religious values (Student 3a, personal communication, Feb 12, 2021). This factor can be related to values of universalism which are connected with individuals

who are less likely to waste food because they care for the welfare of other individuals and nature (Derqui et al., 2018). In the food waste diary, one student commented that the reason why they doesn't throw away food is because "my parents taught me to eat all food". This is in line with a study from Zhao et al. (2019) where participants said that they tried to finish all the food because parents dislike wasting food. Additionally, another student showed a sense of responsibility "Because I do not want to throw away food". Literature highlights that some people feel guilty when they waste food (Derqui et al., 2018). Cecere et al. (2014), in their study of waste prevention and social preferences, conclude that 'Waste reducers' tend to exhibit an altruistic motivation.

5.1.2 Operational drivers

Results from the group interviews and interviews with the key informant highlight *menu composition* as one of the key operational food waste drivers in the school. According to the key informant, vegetarian food, which is served every Thursday, is the type of food thrown away the most (Key informant, personal communication, Feb 22, 2021). This result is in line with previous literature on food waste which highlights vegetarian food as the most thrown away in school canteens in Italy and Spain (Derqui et al., 2018; Falasconi et al., 2015; Lagorio et al., 2018). Data from the food waste diary also gave evidence of this, indicating that on the Thursday surveyed, the rate of food thrown away is higher than the average (Figure 7). On the same Thursday, 66.7% of the students said that they throw away "tacogratin" which is vegetarian food. Additionally, on Tuesday 66.7% of the students threw away potatoes and on Wednesday 50% of the students threw away rice, meaning that menu composition highly influences students' waste rate in our case.

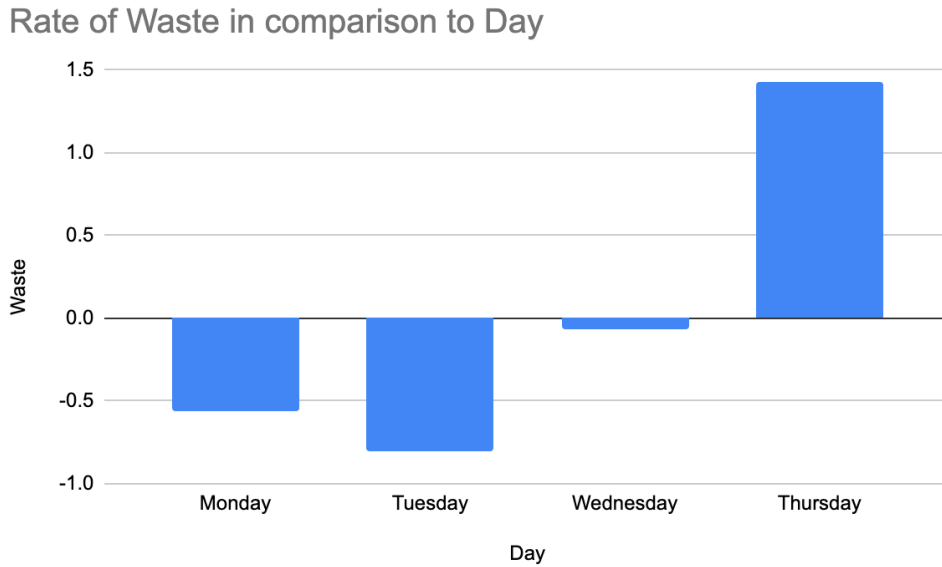


Figure 7. Students' self-assessment of waste generation from March 22th to 25th. Since a different number of students was present in school on different days, data have been normalized. If a particular data point has a normalized value greater than 0, it's an indication that the data point is greater than the mean. Conversely, a normalized value less than 0 is an indication that the data point is less than the mean. (Own creation).

Evidence that menu composition is a driver of food waste is also provided in Questionnaire C, where students were asked to express their food preferences based on the menu. Vegetarian meals, such as goulash with beans (6,9%), vegetarian lasagne (9,7%), soja sausage (6,2%), carrot steaks (8,3%), and chili sin carne (11,7%) are the least liked foods while students like single-served vegetables such as corn (49,3%), tomatoes (41%) and cucumber (62,5%) (Figure 8).

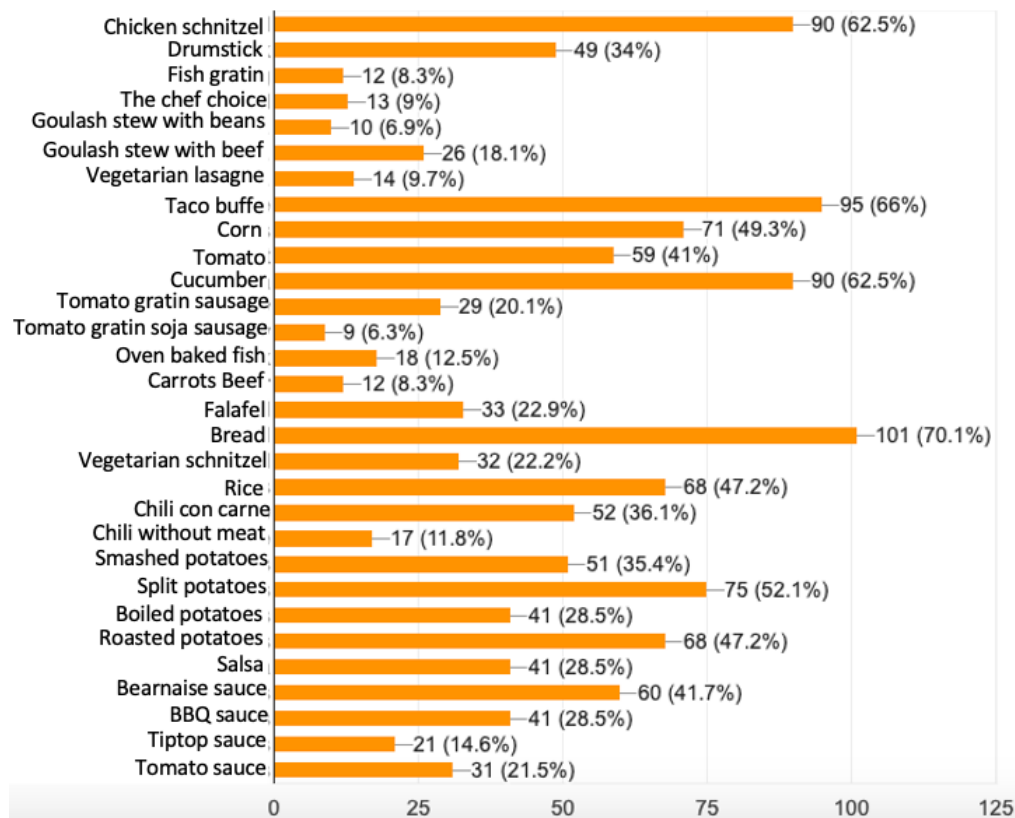


Figure 8. Students' meals preferences. (Own creation).

In relation to *sensory characteristics of food*, firstly, students declare that the food does not taste good. During the group interview one student affirmed that sometimes students take the food but then they start to think it is not good, or they don't know what it is and they do not want to try it (Student 4a, personal communication, Feb 12, 2021). Another student stated that the food tastes bad and that there was a discussion about it with the principal to make it better (Student 5a, personal communication, Feb 12, 2021). The key informant corroborated the student's idea saying that the students complain a lot about the taste resulting in students taking the food but not eating it because they don't like it (Key informant, personal communication, Feb 22, 2021). The key informant says that, from time to time, the food is not tasty, but most of the time it is good enough (Key informant, personal communication, Feb 22, 2021). In Questionnaire B, 4th grade students were asked the reasons why they throw away food. Over 4 days, food was thrown away 36.8% of the time and students stated 56% of the time as a reason that the food was "not good" (Table 3). In a study of food waste generation in South Africa, when students asked why they did not finish their food 73% said because "they did not like the food" (Painter et al., 2016).

Table 3. Reasons why students throw away their food. (Own creation).

Criteria	Throw away food	Criteria	Didn't throw away food
Not good	56.0%	I was hungry	34.9%
I took too much	24.0%	I liked the food	46.5%
Others	20.0%	Others	18.6%
Total	100.0%	Total	100.0%

Martins et al. (2020) found that disliking food was the most common issue affecting children's eating behaviour during school lunches and subsequent plate waste. One reason why students state that the food does not taste good could be because the school does not have an on-site kitchen. The key informant provided details on this point saying that the food is cooked in the kitchen of Kunskapsskolan in Lund (Key informant, personal communication, Feb 22, 2021). Moreover, during the group interview, one student said that meals are heated up at the school (Student 2b, personal communication, Feb 19, 2021). Furthermore, one student, in Questionnaire B, indicated the reason why they threw away food was because the food was "cold". Two studies conducted in the Swedish foodservice sector (Eriksson et al., 2017; Steen et al., 2018) also analysed the role of kitchens in determining food waste quantities and found that schools receiving food from satellite kitchens produced higher levels of food waste compared to those preparing all food by themselves. This is confirmed by Boschini et al. (2020) who underlines higher amounts of diners' leftovers in schools served by external kitchens than in schools with internal kitchens. However, they do not make any links between food cooked and transported from another kitchen and food taste. Therefore further studies should focus on this relation and if this leads to higher food waste generation in schools that receive food from other places.

In addition, students also think that the food does not look good, as one student in the group interview attested to (Student 5a, personal communication, Feb 12, 2021). In this regard, another student stated that when the kitchen uses leftover salad it looks bad, because instead of organizing it by color, which they do on the day when it is first served, they mix it all together and it becomes visually unappealing (Student 6a, personal communication, Feb 12, 2021). Moreover, in the food waste diary, a student explained their reason for throwing away food as "there were black dots all over the peel". Martins et al. (2020) results show that lower levels of satisfaction with meals' taste, appearance, and smell were associated with higher plate waste values. The authors corroborate these results with those observed by Yoon & Kim (2012) in a study developed in Korean primary schools that found that plate waste rates of students satisfied with the school lunch were significantly lower than those of the students who were dissatisfied (Martins et al., 2020). Moreover, a study from Zhao

et al. (2019) have shown that food plating and appearance influenced children's consumption, just as other sensory characteristics, namely taste, texture, colour, and temperature affected meal acceptance.

An additional operational driver of food waste can be found in the fact that *students can serve themselves*. One student explained that students can take as much as they want so then they throw away what is left over (Student 5a, personal communication, Feb 12, 2021). This idea is supported by data from the food waste diary where 24% of the time, students threw away food because they "took too much". In contrast, literature from Folliard et al. (2019) suggest that when students are able to make choices about the food they are eating, like the amount and what type of food, they are less likely to throw away food. In our case, it is not possible to know if food waste is less in the school due to the fact that students serve themselves, but results show that students serving themselves is not a good measure to reduce food waste in school.

5.1.3 Situational drivers

One situational driver influencing food waste production is the *student's appetite*. During a group interview, one student explained that the lunch time differs for each class and it depends on everyday's schedule, ranging from 10:45 to 12:20 (Student 6b, personal communication, Feb 19, 2021). In relation to this, another student said that when they eat around 11, they are not really hungry (Student 4b, personal communication, Feb 19, 2021). Another student added that in that case, students get hungry again around 2pm (Student 7b, personal communication, Feb 19, 2021). Steen et al. (2018), in a study about food waste in Swedish schools, highlight that differences in lunch break procedures should be examined as a factor coupled to food waste behavior. The authors point out that children having lunch 2 hours earlier had significantly higher plate waste than others (Steen et al., 2018).

Another food waste driver is represented by the *access and availability to buy food*. If students are hungry, in the morning or afternoon, they can go to the school snack bar and buy something, as described by a student in the group interview (Student 7b, personal communication, Feb 19, 2021). In a study conducted by Marlette et al. (2005), higher levels of food waste were found among the participants who buy food from the vending machines, suggesting that competitive food items might affect the level of hunger during lunchtime. Boschini et al. (2020) concluded also that higher quantities of diner's leftovers were found in schools where a mid-morning snack was provided. In this regard, Falasconi et al. (2015) in their study of food waste in Italian schools stress that the majority of

students consume packaged sweets and salty snacks as well as sweetened sparkling beverages during the mid-morning break which leads to students refusing food at lunchtime due to loss of appetite. It has been revealed that a similar situation is occurring in Sweden where the majority of gymnasium cafes sell sweets and soda (Livsmedelsverket. n.d.-c). Martins et al. (2020) correlated the high-saturated fat morning snacks and plate waste, considering it extremely worrying since the benefits from the nutritious school lunch were compromised.

5.2 Possibilities and constraints to reduce food waste at Kunskapsskolan in Trelleborg

The analysis of the unstructured interviews with the key informant, the group interviews with the Sustainability Committee, Questionnaire C, and Questionnaire D led us to explore possibilities and constraints on reducing food waste in Kunskapsskolan in Trelleborg. The possibilities and constraints are grouped and explained based on the Three Spheres of Transformation framework.

5.2.1 Personal sphere

The personal sphere includes individual and collective beliefs, values, and worldviews. These shape the ways how people view the systems and structure and how people behave (O'Brien, 2018). *Collective sustainability values* that are shared by stakeholders at Kunskapsskolan in Trelleborg are both a possibility and a constraint in the personal sphere. As a possibility, the principal and some teachers are interested in sustainability issues including reducing food waste in the school. During one of the interviews, the key informant stated that since there was support from the school principal, it was possible to manage projects related to sustainability (Key informant, personal communication, Mar 17, 2021). The key informant also mentioned that there are some teachers who are interested in sustainability (Key informant, personal communication, Nov 22, 2020). However, in contrast, the key informant explained that most of the teachers think that sustainability projects are not necessary and the key informant does not get any cooperation from other teachers (Key informant, personal communication, Mar 17, 2021; Key informant, personal communication, May 4, 2021). Therefore, a constraint is that the majority of the teachers in the school do not have sustainability values, which leads to less participation in reducing food waste. Following O'Brien (2018)'s definition on the personal sphere, we can assume that the values of the teachers have a subconscious impact on the political and practical sphere.

The Three Spheres of Transformation framework explains that discourses and paradigms, which could affect people's perspectives on the issue, could arise from the personal sphere (O'Brien & Sygna, 2013). The interviews with the key informant show that discourses on reducing food waste arose in

the school, but paradigms related to reducing food waste have not emerged yet. This means that reducing food waste issues became a topic to discuss in the school, but it is not a distinct or major one. Once a new paradigm emerges, beliefs and values can be shared by larger groups of people, which can result in powerful consequences (O'Brien & Sygna, 2013). Therefore, a paradigm shift, which includes collective values and beliefs on reducing food waste, needs to be considered and encouraged to reduce food waste in the school.

Students' mindset towards food and food waste is an additional constraint in the personal sphere. As shown in section 5.1, one of the drivers of food waste is the students' lack of knowledge and awareness of the problems of food waste. In Questionnaire C, when students were asked to give suggestions to reduce food waste, one student proposed: "I think it takes a greater understanding among the students to be able to change their mindset, but if you manage to get them to change their mindset, I think half the battle is won". Another student's suggestion of a measure to reduce food waste included: "That everyone is well informed about what they are eating and that all students are told to take smaller portions". Furthermore, another student argued: "Give students insight [to reduce food waste]". These show that students think that some students throw away food because they do not have awareness or values to reduce food waste.

According to O'Brien & Sygna (2013), beliefs, values, and worldviews in the personal sphere are the most difficult ones to transform but they can be influenced through transformative education. Specifically, students' mindsets are likely to be modified through awareness campaigns (Derqui, 2018) that focus on educating students on nutritious food choices and sustainable practices (Lagorio et al., 2018). Through the information campaign, we tried to teach the students about food and food waste to raise awareness and increase knowledge. Among 16 students who answered Questionnaire D, 15 students mentioned that the information campaign influenced them regarding food waste. The information campaign helped students learn more on food and food waste and might provoke curiosity. One student stated: "yes [information campaign influenced me] because I have been able to read and take more". Another student explained: "I have been curious and read posters around the school". This was triangulated during the interview with the key informant. The key informant explained that during the information campaign, the students compared the environmental impacts of different ingredients by themselves and were surprised about the information that they learned (Key informant, personal communication, May 4, 2021). The key informant also mentioned that one of the students was interested in the environmental impacts of meat products, showing her curiosity about becoming vegetarian (Key informant, personal communication, May 4, 2021). Opdal (2001) states that curiosity could lead to perspective changes, so it should be stimulated within education

(Opdal, 2001). This shows that the information campaign helped students get knowledge of food and food waste that could provoke curiosity which could further lead to changes in perspectives.

The information campaign also helped students think more about food and food waste. One student stated “I think I can think more because it says a little about what is in the food”. Another student mentioned: “I think more about where the food comes from”. Furthermore, some students think differently about food and food waste. One student said: “I have started to think differently when I see the amount that is actually thrown away”. Another student also explained: “I think that if I throw away a potato, for example, I throw a lot of water and time”. This could be seen as transformation in the personal sphere where changes in terms of beliefs, values, and worldviews take place. Changes in the personal sphere can create different ways of understanding and interacting with the world (O’Brien & Sygna, 2013).

According to O’Brien and Sygna (2013), changes in the personal sphere could additionally trigger changes in actions and strategies in the practical sphere. In Questionnaire D, one student explained: “It [information campaign] has given me a different picture of the food so that I do not throw away as much anymore”. Another student stated: “I have started throwing [away] as little food as I can”. Another student also said: “I do not throw away as much food as I did before”. Another student also mentioned: “It [information campaign] has changed me a little because I do not throw as much”. All these quotes show that changes in the personal sphere brought changes in actions and helped the students reduce food waste. Kim et al. (2007) state that after students had learning sessions, they showed meaningful changes in behavior. Especially, among all other strategies, explaining the menu and the impacts of the food on health had the most impact on students reducing food waste in the school (Kim et al., 2007). In addition to this, another research conducted by Engström and Carlsson-Kanyama (2004) shows that a food waste awareness campaign, which included measuring plate waste, showing the results in the canteen, and discussing food waste in the classes, helped to reduce food waste by 35%.

5.2.2 Political sphere

The political (or systems) sphere represents the norms, rules, and regulations that facilitate or impede transformations in the practical sphere (Bentz et al., 2019). In this case, we are looking at the current canteen system to identify connections with students’ food waste. There are several constraints under the current canteen system.

First of all, current *meal preparation*, which is related to taste and temperature of food, has been identified as a constraint. In fact, in Questionnaire C, 10.3% of the students pointed out that “better quality of food” could be a strategy to reduce food waste. One student stated: “Even serving better

food so you want to eat would have helped [to reduce food waste]”. Another student also mentioned: “Better food so more people eat it”. Furthermore, another student explained: “higher quality ingredients will of course cost more but food waste will decrease”. In addition to this, different students pointed out that food is cold and the availability of “warm food” would decrease food waste. One student said: “not [serve] cold food products that should actually be hot, not [serve] old food”. These factors are likely related to the fact that the school doesn’t cook the food in their canteen as mentioned in section 5.1.2. Lagorio et al. (2018) mentions that improving the supply chain of the canteen food could reduce food waste. For example, the selection of raw ingredients, preparation and storage will improve the quality of the food, which could lead to reducing food waste (Lagorio et al., 2018). Therefore, improving meal preparation could lead to reducing food waste in Kunska skolan in Trelleborg.

Another constraint derived from the current canteen system is the way of *displaying food* which does not stimulate students’ appetite. In Questionnaire C, one student suggested: “make the food look good on the serving table [in order to increase students' willingness to eat it and not throw it away]”. Another student explained further: “Do not mix the vegetables, but corn in a container, cucumber in one, salad in one and so on”. These were triangulated through the group interviews with the Sustainability Committee. One student said that making food look good would help students with eating disorders as well (Student 3b, personal communication, Feb 19, 2021). Another Sustainability Committee student suggested starting displaying food better with salad bars. The student mentioned that they tried it before and students liked it, so it would be good to continue (Student 1b, personal communication, Feb 19, 2021). Martins et al. (2020) suggest to improve the appearance of school lunches by making changes in related school food policies and having workshops about ways to plate the meals, which will lead to food waste reduction. Lagorio et al. (2018) also suggest to give “greater attention to the composition and presentation of menus and dishes from the perspective of content and appearance” as a strategy to reduce food waste in school canteens (p. 78). This is confirmed by Falasconi et al. (2015) who underline focusing on the presentation of food as a preventive procedure to food waste. Therefore, according to students, improving the school canteen system by changing the way the food is displayed could be helpful in reducing food waste.

Another constraint to reduce food waste related to the current canteen system is that the school has limited types of *options in the menu*. For this, one student suggested: “More options that the children like. Other options when it is vegetarian [day]. Bread [could be added] so you get something if you do not like the food”. Another student proposed: “No vegetarian day [in order to reduce food waste]”. The school canteen offers only vegetarian food on Thursdays as shown in the section 5.1 and it is the most thrown away by students. From the interviews, the Sustainability Committee students and the

key informant pointed out menu composition, especially vegetarian food, as one of the drivers of food waste. In Questionnaire C, there were also suggestions to diversify the menu based on cultural differences. One student mentioned: “get halal food”. Another suggested: “Increase Arabic and Balkan food”. Derqui et al. (2018) mentions changing menus based on students’ preferences as one solution to reduce food waste. One of the implemented measures was voting on the menu, which was conducted to see students’ preferences and suggest different menus to reduce food waste. The key informant mentioned that the school is going to analyze the result of the vote and make changes in the menu (Key informant, personal communication, May 4, 2021). However, eliminating vegetarian day could be controversial since vegetarian meals are recognized as a method to reduce environmental impacts from food consumption (Leuenberger et al., 2010). According to a research from Leuenberger et al. (2010), average meat-based meals have more environmental impacts, for example producing 2 kg more GHG emissions, than vegetarian meals. This means that eliminating vegetarian day might help to reduce food waste in the school canteen, but it might have consequences for the total environmental impacts of food consumed in the school canteen.

Moreover, the school allows *students to serve themselves in the canteen*. This procedure is another constraint to reduce food waste. In fact, students can serve themselves as much food as they want and they can throw it away if they don’t like it or they cannot finish it, as shown in 5.1. Regarding this, one student suggested: “[change to] smaller plates, then you do not take as much”. Two students suggested: “A more radical solution would be to remove the trash bin” and: “have no trash bin [could reduce food waste]”. Furthermore, one student mentioned: “maybe acquire some rules”. Derqui et al. (2018) suggest hiring a meal supervisor to enforce the rule that students are not allowed to leave the canteen before emptying their plates in order to reduce food waste (Derqui et al., 2018). Martins et al. (2020) highlighted the need for teachers to eat with students in the school canteens to encourage them to eat and try new foods, to teach them how to behave in the canteens, and to discuss food and nutrition during the meal.

Additionally, one constraint to reduce food waste was identified in the *dining ambiance*. One student in Questionnaire C suggested “slightly nicer dining room that people actually want to be in and eat there”. The Swedish National Food Agency mentions that in addition to the quality of food, other factors such as design, smell, and sound of the canteen could affect eating behavior (Livsmedelsverket, n.d.-d). Derqui et al. (2018) suggest minimising noise and dining room decoration so that it creates a more relaxed and home-like ambience as a strategy to reduce food waste.

Lastly, under the current canteen system, students are not allowed to save their leftovers which could be a constraint to reduce food waste in the school. In Questionnaire C, one student suggested: "That students can take home the food that is leftover". This was triangulated through the group interviews with the Sustainability Committee. One student proposed to bring a food container, so students can bring the leftovers back home (Student 3b, personal communication, Feb 19, 2021). However, another student specified that they already asked the administration if they can bring a food container but there was no reply (Student 1b, personal communication, Feb 19, 2021). Regarding this, the key informant pointed out that there are some concerns related to it (Key informant, personal communication, Feb 23, 2021). The key informant mentioned: "we can't keep track of an actual consumption of the collected leftovers, hence no possibility to track how much of those are wasted" (Key informant, personal communication, Feb 23, 2021). The key informant was also concerned that since students do not have a fridge to keep leftover food for the afternoon, and if it goes bad, the responsibility would fall on the school (Key informant, personal communication, Feb 22, 2021; Key informant, personal communication, Feb 23, 2021).

5.2.3 Practical sphere

The practical sphere is the "outcome" sphere which includes changes in strategies, practices, and behaviors (O'Brien & Sygna, 2013). One possibility in the practical sphere is *measuring the amount and type of food waste*. During the group interviews with the Sustainability Committee students, we discussed the idea of *measuring food waste* and students agreed that it was a good idea (Student 1b, personal communication, Feb 19, 2021). This was triangulated through Questionnaire C in which one student stated: "[to reduce food waste it would be helpful to] find out how much we throw away" while another specified: "Find out what we eat when we throw away the most and reduce that food". However, the key informant explained in the interview that such a strategy is already in action and they have statistics on food waste (Key informant, personal communication, Feb 22, 2021). From this, we could tell that the students are not informed about this measure. Derqui et al. (2018) suggest communicating results of food waste audits with students in order to raise awareness on the problem. While the school is measuring the amount of food waste in the whole school which represents an opportunity to reduce food waste in the practical sphere, it is also important to establish a system to share the results of measuring food waste with the students.

Another possibility related to measuring food waste is a zero food waste competition between classes. During the group interviews, one student said that they already tried it in their class, but this time it could be compared with other classes (Student 7b, personal communication, Feb 19, 2021).

Another student stated that it would be fun to compete with other classes and students would enjoy participating in it (Student 6b, personal communication, Feb 19, 2021). This idea was also expressed in Questionnaire C, where one student suggested: “[it would be good to] have some kind of competition, for example, the class that throws the least must decide a dish [menu], this happens every month”. Some other students also showed that they want to get rewards in return for reducing food waste. During the group interviews, one Sustainability Committee student asked if it is possible to get a prize if students do not throw food away, mentioning that this would make more students participate and motivated for the zero food waste competition (Student 2c, personal communication, Mar 5, 2021). Just and Price (2013) found that incentives have a significant influence on encouraging children to eat fruits and vegetables during lunch at school: the fraction of students eating servings of fruit and vegetables increased by 80% when incentivized in their research, and waste was reduced by 33%.

The food waste diary, which was one of the measures implemented to trigger changes in the students’ behavior, represents a possibility to reduce food waste. Among 16 students who answered Questionnaire D, 13 students mentioned that the food waste diary influenced them regarding food waste. In Questionnaire D, students mentioned that the food waste diary helped students to think more and reminded them about food and food waste. One student stated: “It [the food waste diary] makes me think more about the food”. Another student said: “I think more about it [food waste]”. In addition to this, one student mentioned: “It [the food waste diary] reminds me [of food waste]”. Another student elaborated: “when I throw away a lot of food, I see that I have thrown away a lot, and that's not so good”. Another student also stated: “it [the food waste diary] does [influence attitude] so that you remember not to throw away food”. Moreover, one student elaborated: “I think it's pretty good what we have done here at school because you keep more track of how much you waste when we throw away the food”. During the interview, the key informant mentioned that students started to remind each other to take less food if they don’t like the food (Key informant, personal communication, May 4, 2021). The key informant also stated that it is really important to remind and keep mentioning food waste to the students (Key informant, personal communication, May 4, 2021).

Furthermore, students also stated that the food waste diary has influenced students’ behavior to throw away less food. One student explained: “I have started throwing less because when you think about how much you throw, it was a lot before”. Another student said: “Now I see how much is thrown away. I think of those who do not get any food at all, and therefore I take a little less so that I eat everything”. Also, one student mentioned: “I think I will try to eat my food before I throw it away”. Furthermore, another student said: “I have thrown less both at home and at school because now it's like a bigger thing to talk about”. This last quote shows that the behavioral change could not

only occur in the school but also occur beyond the school. This was triangulated during the interview with the key informant. The key informant stated that the students tried to not throw away food (Key informant, personal communication, May 4, 2021). For example, the students took small portions when they were not sure if they liked the food and they took more food after trying it (Key informant, personal communication, May 4, 2021). The key informant mentioned that continuing the food waste diary would trigger much more changes (Key informant, personal communication, May 4, 2021). These could be seen as the “outcome” of the measures implemented, and the start of a transformation in practices and behaviors in the practical sphere (O’Brien & Sygna, 2013).

5.3 Last remarks and suggestions for further research

A summary of possibilities and constraints to reduce plate food waste in Kunskapsskolan in Trelleborg is provided in Figure 9. Data shows that the factors that influence food waste generation in Kunskapsskolan in Trelleborg can be summarized as behavioral, operations, and situational, as categorized by the UK’s Waste and Resources Action Programme (2011). Even after we attempted to tackle students’ awareness and behaviors respectively with the information campaign and the food waste diary, food waste was not completely eliminated. This is because change happens slowly and it would not be reasonable to expect to achieve zero food waste with measures implemented in only one week. In addition, our project provided only information related to the environmental footprint of food, but the effect of eating seasonal and local food should be addressed as there was a significant lack of knowledge from the students. Moreover, as shown in Figure 9, most of the constraints to currently reduce food waste at Kunskapsskolan are situated in the political sphere. Therefore, Figure 9 underlines the significance to holistically integrate personal, political, and practical spheres in projects to reduce food waste in order to achieve a significant transformation of the issue. This should be the focus of further research in the context of food waste in school canteens. Moreover, when integrating the three spheres it is also important to consider the different dimensions of food waste in school canteens, namely plate waste, serving waste, and kitchen waste. The boundaries of this study is limited to plate waste only but all three of them should be considered in order to tackle the problem. In terms of solutions, recovery measures for food waste such as donating or composting should be considered as well.

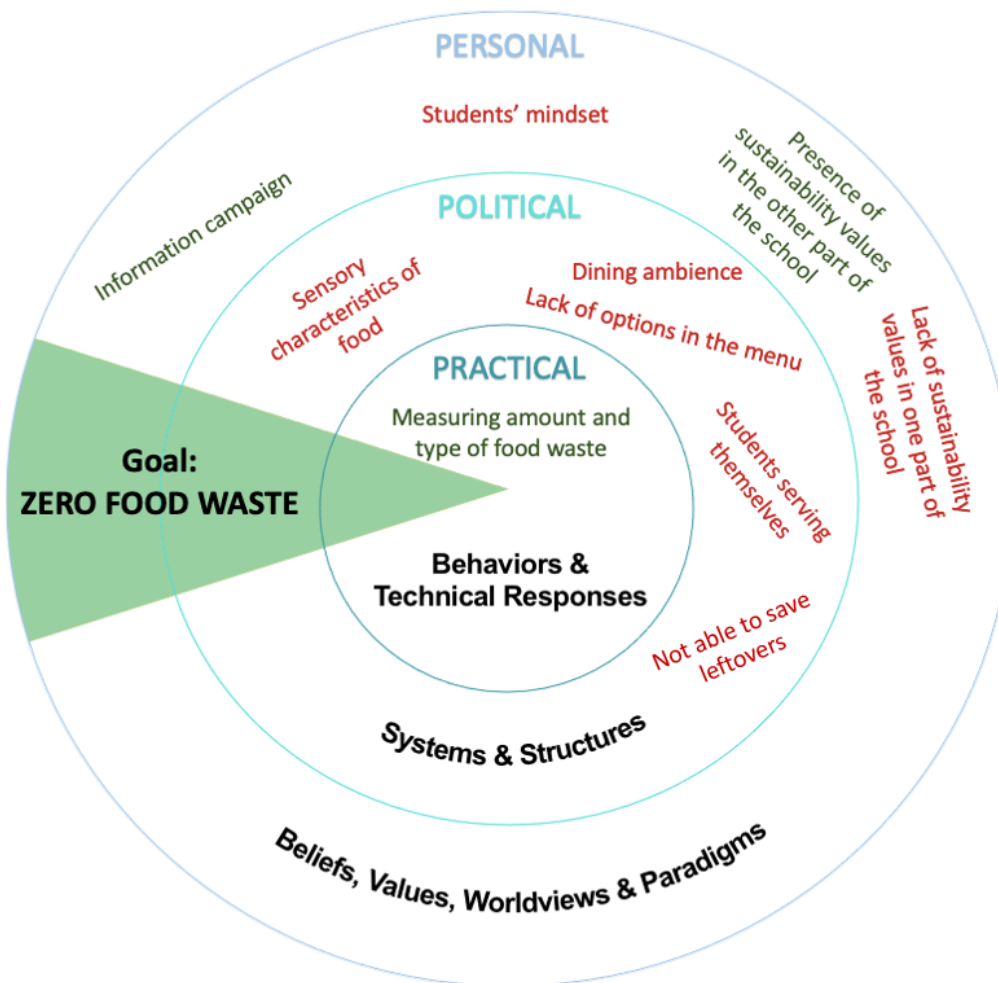


Figure 9. Identified possibilities and constraints to reduce food waste in Kunskapsskolan. Using the Three Spheres of Transformation adopted from O'Brien and Sygna (2013) we organized the identified possibilities (green) and constraints (red) to food waste reduction in the personal and political spheres. (Source: Based on the Three Spheres of Transformation by O'Brien and Sygna, 2013, and modified by the authors).

Finally, contrasting results have emerged on which approach would be more effective to induce behavioral changes. On one hand, students declared that the implemented activities were fun and this led to a change in habits. However, when students were asked for suggestions on how to reduce food waste, some of them pointed to imposing discipline on students through rules or the elimination of trash bins from the canteen. Thus, further research should focus on the reward versus sanction approaches to food waste reduction in school canteens.

6. Conclusion

Food waste problems around the world are alarming as one third of the global food production for human consumption is wasted. Food waste in schools is especially noticeable due to its amount and potential to reduce it.

Our study contributes to the literature on food waste by further identifying drivers of food waste and exploring possibilities and constraints to reduce food waste in Kunskapsskolan in Trelleborg. The results show that the personal sphere is closely linked to the behavioral drivers of food waste, including lack of environmental awareness and knowledge, social context, and cultural, religious, and social norms. The political sphere is connected with the operational and the situational drivers which respectively include: menu composition, sensory characteristics of food, serving style of the canteen and students' appetite, and access and availability to buy food. The practical sphere involved measuring the amount of food and types of food waste in the school canteen and a food waste diary, which was one of the implemented measures. The results show that all three spheres, the personal, political, and practical, should be considered to reduce food waste in the school canteen.

Our study also contributes to sustainability science by showing that education on food and food waste helps students transform their thoughts and behavior in regard to it, therefore supporting transitions towards sustainability. In fact, results show that the information campaign and the food waste diary have triggered changes in behavior and awareness. Thus, this study could help to achieve UN Sustainable Development Goal 12.3 to cut 50% per capita food waste at the retail and consumer level by 2030. The study could also be used to reduce food waste in other Kunskapsskolan which might present similar drivers of food waste as well as possibilities and constraints to reduce it.

7. References

- Barth, M., & Michelsen, G. (2013). Learning for change: an educational contribution to sustainability science. *Sustainability science*, 8(1), 103-119.
- Bentz, J., O'Brien, K., Iles, A., & Milkoreit, M. (2019). ART FOR CHANGE: Transformative learning and youth empowerment in a changing climate. *Elementa: Science of the Anthropocene*, 7.
- Boschini, M., Falasconi, L., Cicatiello, C., & Franco, S. (2020). Why the waste? A large-scale study on the causes of food waste at school canteens. *Journal of Cleaner Production*, 246, 118994.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Bryman, A. (2012). *Social research methods*. Oxford university press.
- Buckler, C., & Creech, H. (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development; final report*. Unesco.
- Byker, C. J., Farris, A. R., Marcenelle, M., Davis, G. C., & Serrano, E. L. (2014). Food waste in a school nutrition program after implementation of new lunch program guidelines. *Journal of nutrition education and behavior*, 46(5), 406-411.
- Castro, P. (2015). Two Nations and ESD: Analysis of the Implementation of Education for Sustainable Development (ESD) in Ecuador and Sweden for grades 1 to 10. *IIIEE Master thesis*.
- Cecere, G., Mancinelli, S., & Mazzanti, M. (2014). Waste prevention and social preferences: the role of intrinsic and extrinsic motivations. *Ecological Economics*, 107, 163-176.
- Clark, W. C. (2007). *Sustainability science: A room of its own*.
- Clark, J. S., Porath, S., Thiele, J., & Jobe, M. (2020). *Action research*. New Prairie Press.
- Davis, J. (2010). Early childhood education for sustainability: Why it matters, what it is, and how whole centre action research and systems thinking can help. *Journal of Action Research Today in Early Childhood*, 2010(April), 35-44.
- Depta, L. (2018, September). *Global Food Waste and its Environmental Impact: Green Living*. Retrieved May 2, 2021, from <https://en.reset.org/knowledge/global-food-waste-and-its-environmental-impact-09122018#>
- Derqui, B., Fernandez, V., & Fayos, T. (2018). Towards more sustainable food systems. Addressing food waste at school canteens. *Appetite*, 129, 1-11.
- Engström, R., & Carlsson-Kanyama, A. (2004). Food losses in food service institutions Examples from Sweden. *Food policy*, 29(3), 203-213.
- Eriksson, M., Osowski, C. P., Malefors, C., Björkman, J., & Eriksson, E. (2017). Quantification of food waste in public catering services—A case study from a Swedish municipality. *Waste Management*, 61, 415-422.

- Falasconi, L., Vittuari, M., Politano, A., & Segrè, A. (2015). Food waste in school catering: an Italian case study. *Sustainability*, 7(11), 14745-14760.
- FAO. (2011). Global food losses and food waste: extent, causes and prevention. In: Study Conducted for the International Congress SAVE FOOD! at Interpack2011. Food and Agriculture Organization of the United Nations, Düsseldorf, Germany.
- FAO (n.d). Indicator 12.3.1 - Global Food Loss and Waste. (n.d.). Retrieved from <http://www.fao.org/sustainable-development-goals/indicators/12.3.1/en/>
- Folliard SDSU Extension Family & Community Health Field Specialist, J., Hardy, M., & Benson, F. (2019, November 01). Food Waste in Schools and Strategies to Reduce It. Retrieved March 24, 2021, from <https://extension.sdstate.edu/food-waste-schools-and-strategies-reduce-it>
- Food and Agriculture Organization (FAO), 2013. “Food wastage footprint – Impact on natural resources (Summary report)”. Food and Agriculture Organization of the United Nations. ISBN: 978-92-5-107752-8.
- García-Herrero, L., De Menna, F., & Vittuari, M. (2019). Food waste at school. The environmental and cost impact of a canteen meal. *Waste Management*, 100, 249-258.
- Just, D. R., & Price, J. (2013). Using incentives to encourage healthy eating in children. *Journal of Human resources*, 48(4), 855-872.
- Kasavan, S., Ali, N. I. B. M., Ali, S. S. B. S., Masarudin, N. A. B., & Yusoff, S. B. (2021). Quantification of food waste in school canteens: A mass flow analysis. *Resources, Conservation and Recycling*, 164, 105176.
- Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., ... & Svedin, U. (2001). Sustainability science. *Science*, 292(5517), 641-642.
- Kerton, S., & Sinclair, A. J. (2010). Buying local organic food: A pathway to transformative learning. *Agriculture and Human Values*, 27, 401–413.
doi:<http://dx.doi.org/10.1007/s10460-009-9233-6>
- Kim, S. H., Choe, E. H., Lee, G. E., & Gwak, D. G. (2007). Effects of nutrition education on food waste reduction. *Journal of the Korean Dietetic Association*, 13(4), 357-367.
- Kunskapsskolan. (n.d.). What is Kunskapsskolan?. Retrieved February 26, 2021, from <https://www.kunskapsskolan.se/sprak/in-english>
- Lagorio, A., Pinto, R., & Golini, R. (2018). Food waste reduction in school canteens: Evidence from an Italian case. *Journal of cleaner production*, 199, 77-84.
- Leavy, P. (2017). Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches.
- Leuenberger, M., Jungbluth, N., & Büsser, S. (2010). Environmental impact of canteen meals: comparison of vegetarian and meat based recipes. *Int J Life Cycle Assess*, 9, 1-5.

- Livsmedelsverket. (n.d.-a). School lunches. Retrieved 1 April 2021, from <https://www.livsmedelsverket.se/en/food-habits-health-and-environment/maltider-i-var-d-skola-och-omsorg/skola>
- Livsmedelsverket. (n.d.-b). Retrieved 1 April 2021, from <https://www.livsmedelsverket.se/matvanor-halsa--miljo/maltider-i-var-d-skola-och-omsorg/matsvinn-i-storkok>
- Livsmedelsverket. (n.d.-c). Retrieved 1 May 2021, from <https://www.livsmedelsverket.se/matvanor-halsa--miljo/maltider-i-var-d-skola-och-omsorg/skola?AspxAutoDetectCookieSupport=1>
- Livsmedelsverket. (n.d.-d). Retrieved 1 May 2021, from <https://www.livsmedelsverket.se/matvanor-halsa--miljo/maltider-i-var-d-skola-och-omsorg/matsvinn-i-storkok/handbok-for-minskat-matsvinn/minska-matsvinnet--sahar-gor-du/tallrikssvinn/trivsamtidsmiljo?AspxAutoDetectCookieSupport=1>
- Macdiarmid, J. I. (2014). Seasonality and dietary requirements: will eating seasonal food contribute to health and environmental sustainability?. *Proceedings of the Nutrition Society, 73*(3), 368-375.
- Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *All Ireland Journal of Higher Education, 9*(3).
- Marlette, M., Templeton, S.B., Panemangalore, M., 2005. Food type, food preparation, and competitive food purchases impact school lunch plate waste by sixth- grade students. *J. Am. Diet. Assoc. 105*, 1779e1782. <http://10.1016/j.jada.2005.08.033>.
- Marshall, M. N. (1996). The key informant technique. *Family practice, 13*, 92-97.
- Martins, M. L., Rodrigues, S. S., Cunha, L. M., & Rocha, A. (2020). Factors influencing food waste during lunch of fourth-grade school children. *Waste Management, 113*, 439-446.
- Mochizuki, Y. (2016). Educating for Transforming Our World: Revisiting International Debates Surrounding Education for Sustainable Development. *Current Issues in Comparative Education, 19*(1), 109-125.
- O'Brien, K. (2018). Is the 1.5 C target possible? Exploring the three spheres of transformation. *Current Opinion in Environmental Sustainability, 31*, 153-160.
- O'Brien, K., & Sygna, L. (2013). Responding to climate change: the three spheres of transformation. *Proceedings of transformation in a changing climate, 16*, 23.
- O'Neil, J. K. (2018). Transformative sustainability learning within a material-discursive ontology. *Journal of Transformative Education, 16*(4), 365-387.
- Opdal, P. M. (2001). Curiosity, wonder and education seen as perspective development. *Studies in philosophy and education, 20*(4), 331-344.
- Painter, K., Thondhlana, G., & Kua, H. W. (2016). Food waste generation and potential interventions at

- Rhodes University, South Africa. *Waste Management*, 56, 491-497.
- Ritchie, H., & Roser, M. (2020, January 15). Environmental impacts of food production. Retrieved May 10, 2021, from <https://ourworldindata.org/environmental-impacts-of-food#citation>
- Schnitzler, T. (2019). The bridge between education for sustainable development and transformative learning: Towards new collaborative learning spaces. *Journal of Education for Sustainable Development*, 13(2), 242-253.
- Sipos, Y., Battisti, B., & Grimm, K. (2008). Achieving transformative sustainability learning: engaging head, hands and heart. *International journal of sustainability in higher education*.
- Spangenberg, J. H. (2011). Sustainability science: a review, an analysis and some empirical lessons. *Environmental Conservation*, 38(3), 275-287.
- Steen, H., Malefors, C., Rööf, E., & Eriksson, M. (2018). Identification and modelling of risk factors for food waste generation in school and pre-school catering units. *Waste Management*, 77, 172-184.
- Thompson, C. B. (2009). Descriptive data analysis. *Air medical journal*, 28(2), 56-59.
- Tilbury, D. (1995). Environmental education for sustainability: defining the new focus of environmental education in the 1990s. *Environmental Education Research*, 1(2), 195–212.
- United Nations Conference on Environment and Development (UNCED). (1992). Agenda 21, Rio Declaration, Forest Principles. New York: United Nations.
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (2012). *Education for sustainable development: building a better, fairer world for the 21st century*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000216673>
- United Nations Educational, Scientific and Cultural Organization (UNESCO). (2020). Education for Sustainable Development. Retrieved from: <https://en.unesco.org/themes/education-sustainable-development>
- Waste and Resources Action Programme (2011). *Food waste in schools, Banbury, Oxon*. Retrieved from <http://www.wrap.org.uk/sites/files/wrap/FoodWasteinSchoolsSummaryReport.pdf>.
- Westöf, A. K., & Jensen, C. (2018). *Matavfall i Sverige. Uppkomst och behandling 2016* (Rep.). Naturvårdsverket.
- Wiek, A., Farioli, F., Fukushi, K., & Yarime, M. (2012). Sustainability science: bridging the gap between science and society. *Sustainability Science*, 7(1), 1-4.
- Wilkie, A. C., Graunke, R. E., & Cornejo, C. (2015). Food waste auditing at three Florida schools. *Sustainability*, 7(2), 1370-1387.
- Yoon, S.-J., & Kim, H.-A. (2012). Elementary school students' perception of food waste and factors affecting plate waste rate of school foodservice in the gyeongnam area. *Journal of the Korean Dietetic Association*, 18(2), 126–140. <https://doi.org/10.14373/JKDA.2012.18.2.126>.

Zhang, Y., & Wildemuth, B. M. (2009). Unstructured interviews. Applications of social research methods to questions in information and library science, 222-231.

Zhao, C., Panizza, C., Fox, K., Boushey, C. J., Shanks, C. B., Ahmed, S., ... & Banna, J. (2019). Plate waste in school lunch: barriers, motivators, and perspectives of SNAP-eligible early adolescents in the US. *Journal of nutrition education and behavior*, 51(8), 967-975.

Appendices

Appendix A. Questionnaire A

- How much do you know about each of these topics?

[How food is produced] I know a lot/I know a little / I don't know

[How food is transported] I know a lot/I know a little / I don't know

[What is seasonal and local food] I know a lot/I know a little / I don't know

- Are the following good or bad for the environment?

[Throwing away food you don't finish] Very good/Good/No Effect/Bad/Very Bad

[Eating seasonal food] Very good/Good/No Effect/Bad/Very Bad

- How often do you...

[think about how your food is produced?] Very often/often/sometimes/rarely/never

[think about how the food you eat is transported?] Very often/often/sometimes/rarely/never

[think about the environment when purchasing food?] Very often/often/sometimes/rarely/never

- How often do you... [throw away your food?] Very often/often/sometimes/rarely/never

Appendix B. Information campaign material examples



NUTRIENTS



Protein, Vitamin D, Iron

CARBON FOOTPRINT

75g 1-2 times a week over a year contributes to 106 kg of greenhouse gas emissions. This is equivalent to driving a car 438 km



FUN FACT

Chicken produces the least greenhouse gas emissions among the most popular types of meat during each phase of production, processing and cooking.

WATER FOOTPRINT

For 75g chicken 1-2 times a week over a year, 7,134 liters of water are needed. This corresponds to 109 showers lasting 8 minutes each.



Appendix C. Questionnaire B

Food waste diary

- For which date do you write the food waste diary? Monday/Tuesday/Wednesday/Thursday
- Gender
- Food and quantity discarded. (If you did not throw away food, go to the last question)
For example: one falafel, 1 spoon of mashed potatoes, nothing, etc.
- Why did you throw away the food?
- If you did not throw away food, why?

Appendix D. Questionnaire C

- Choose all the food you like in the school menu:

Chicken schnitzel

Drumstick

Fish gratin

the chef choice

Goulash with beans

Goulash with beef

Vegetarian lasagne

Tacobuffe

Corn

Tomato

Cucumber

Tomato gratin sausage

Tomato gratin soja sausage

Oven Baked fish

Carrot Steak

Falafel

Bread

Vegetarian schnitzel

Rice

Chili con carne

Chili without meat

Smashed Potatoes

Split potatoes

Boiled potatoes

Roasted potatoes

salsa

Bearnaise sauce

BBQ sauce

tiptop sauce

Tomato sauce

- Is there any type of food that is not on the menu and would you like to suggest that you add it?
- If you have any suggestions for reducing food waste in the school canteen, feel free to write it down here.

Appendix E. Questionnaire D

- Did the information campaign affect your attitude (thoughts or feelings) towards food waste? If so, how? If not, why not?
- Have you written a food waste diary that affects your attitude (thoughts or feelings) towards food waste? If so, how? If not, why not?
- Write everything you want to say about the activities. For example, what did you like / dislike about the activities, what did you feel about each activity, how can you improve, what would you do differently?

Appendix F. Interview guidelines for group interview n.2

- What do you think about doing a food waste audit in the school canteen or at individual level?
- What do you think about involving students in food menu selection, for example voting on the menu or changing the design of the menu hanging in the canteen with a more colorful and attractive one? Would students be interested in reading about the health benefits of food in the menu? What about using the menu for an information campaign environmental footprint of food (carbon footprint, energy footprint and water footprint) or storytelling for thematic days to explore new cultures?
- Are there any canteen operations that are inefficient and could need to be improved? For instance, is the waste just from students or also from the kitchen? Has food been cooked but not served? Is the food prepared where it is consumed?
- Are students hungry when they sit for lunch? Is there a morning fika that can influence the students' appetite? Are physical activities scheduled before or after lunch?
- What kind of policy the school follows: serve or offer food?
- What do you think about having a sharing table where students drop food that they don't want to eat for others to grab? (types of food could be: packaging food or fruit)
- What do you think about doing a zero food waste competition in class?
- What do you think about doing food re-purpose labs? For instance cooking lab with leftovers from the kitchen or dying clothes with food waste?
- Would you like the food to look better?
- What do you think about doing a zero food waste week challenge?
- What do you think about bringing a food container or doggy bag to bring home leftovers?
- What do you think about having the school donating leftover food to local farmers or food organizations or vulnerable families?
- What do you think about creating a compost program at the school?