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**Reducing food waste: An investigation of the Food Waste Literacy of Year
7 students in a New Zealand School**

A thesis

submitted in fulfilment

of the requirements for the degree

of

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at

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Abstract

Food waste is a widespread global issue. Food is wasted at various stages of the food supply chain and there are unique reasons for wastage at each stage, in different countries. Whatever may be the reason, food waste has social, economic, and environmental impacts which can be felt globally. It is unethical to waste food when there are so many hungry people in the world. It is a waste of our precious resources and a burden on our precarious food situation. Food waste in landfills releases methane - a harmful greenhouse gas, which adds to global warming, and a harmful liquid called leachate which is toxic to the environment.

Food waste is a major issue globally and also in New Zealand. Fortunately, food waste at the consumers' level may be reduced by developing their Food Waste Literacy. I explored existing studies and ideas in Food Literacy. However, the current definition of Food Literacy only includes the health and nutrition aspect of food. Therefore, the inclusion of food waste in Food Literacy warrants an explicit need at this point in time. Therefore, I proposed the term Food Waste Literacy in this study, which is the literacy for the judicious use of food, by acquiring the ability to use the food produced efficiently, with an understanding of concepts ranging from the production to consumption of food. Food Waste Literacy may include knowledge, attitudes and values, and behaviour towards food waste. This literacy may be situated alongside Environmental Literacy and may be developed by implementing a similar framework.

The purpose of this study was to explore and develop the Food Waste Literacy of Year 7 students in a school in New Zealand. Primarily, the focus of my study was (1) to explore the students' Food Waste Literacy, (2) to design an intervention to engage these students in developing their Food Waste Literacy, and (3) to explore the effect of the intervention in activating the students' inquiry and decision making about Food Waste Literacy. I employed a convergent parallel mixed methods design in this case study. For this purpose, I collected qualitative data using class observations and focus group interviews, which were analysed using the thematic analysis. For the quantitative analysis, I collected responses from a questionnaire, before and after the class intervention. To analyse this data, I used mean, median, and standard deviation under descriptive statistics. I also collected qualitative data from the class teacher through interviews, as she was another stakeholder in this intervention for developing the students' Food Waste Literacy.

Findings after the intervention indicated an enhanced Food Waste Literacy among the students and the teacher. There was a positive shift in the students' knowledge about food waste and its various aspects including the reasons for food waste, ways of prevention of food waste, and its environmental, social, and economic implications. The students reported attitudes indicated their better decision-making involving food waste. Their reported behaviour suggested that they would make better decisions involving food purchase and consumption, which was also visible in almost negligible food waste in the classroom. However, some barriers were also identified which may influence the development of the students' Food Waste Literacy.

My study and its findings, highlights the gap in the existing concept of food literacy and informs the development of students' Food Waste Literacy by creating appropriate opportunities in the curriculum.

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“I sustain myself with the love of family.” — Maya Angelou

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Dedication

“For Papa, who taught me to work hard.”

Conference and Seminar presentations arising from this thesis

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Chapter 1

Introduction

1.1 Chapter Overview

In this introductory chapter, I elaborate on the rationale of the study, my background and motivation for this research, scope of the research, and the gaps identified in current research. I also discuss the research questions, significance of the study, and an overview of the research design. Lastly, I present the structure of this thesis.

1.2 Rationale for the study

An extensive report covering global food losses and food waste, its causes, its extent and its prevention, was published by the Food and Agricultural Organisation of the United Nations (FAO), in 2011 (Gustavsson, Cederberg, Sonesson, van Otterdijk, & Meybeck, 2011). This report was a breakthrough in the field of global food loss and food waste and captured the world's attention at the time. The report highlighted that roughly one-third of food produced for human consumption was lost or wasted globally, which amounted to approximately 1.3 billion tonnes per year (Gustavsson et al., 2011). It was also reported that food loss usually occurs in the initial stages of the Food Supply Chain (FSC) in production and harvesting while food waste usually occurs at the consumption stage or household levels. There can be several reasons for food losses in different countries depending on the many conditions like infrastructure, channels for distribution and consumer purchasing, and food use practices. Whereas food waste occurs at the retailer or the consumer level and is generally avoidable. According to the latest food waste index report by the United Nations Environmental Programme (UNEP), it is estimated that food waste from households, the retail sector and food service industry, totals 931 million tonnes each year (UNEP, 2021). Out of this, nearly 570 million tonnes of food waste occurs at household levels which amounts to approximately 74 kg of food waste per capita per year, right from lower-middle to high-income countries (UNEP, 2021). In the context of New Zealand, over 224,000 tonnes of food waste was generated by households alone in 2011, with the food industry producing over 103,000 tonnes of food waste (Reynolds, Mirosa, & Clothier, 2016).

This food waste impacts people and the planet in considerable ways, in terms of social, humanitarian, economic, and environmental costs. According to the United Nations Regional Information Centre for Western Europe (UNRIC), there were eight hundred and fifteen million undernourished people globally (UNRIC, 2018) and the number of these people is expected to rise with the population growing by another 2 billion by 2050 (World Health Organization, 2017). The United Nation's Food and Agricultural Organisation (FAO) estimated that there were 690 million hungry people in 2019, and it is likely that the global number of hungry people in the world in 2030, would exceed 840 million (FAO, 2020). With regard to New Zealand, the *New Zealand Health Survey* reported that there were almost 12 per cent of children living in food insecure households in 2020/2021 which was seen as an important public policy concern from the perspective of the rights of children and potential education consequences (Ministry of Health, 2021).

The economic impacts of food waste are also substantial and amount to about USD 1 trillion each year or a total of USD 2.6 trillion if the social and ecological costs are also accounted for (FAO, 2022). About NZD 3.1 billion worth of food is wasted by the households in New Zealand which costs an average of \$644 per household per year (WasteMINZ, 2018).

Moreover, food waste is also a waste of valuable resources like land, water, energy, labour, and other inputs that are used in producing, processing, transporting, preparing, and storing of food, and disposing of discarded food (U.S. Department of Agriculture, 2021). According to the latest projections of the United Nations (UN), the global population could grow to over 9.7 billion by 2050 and an equivalent of almost three planets could be needed to provide the natural resources needed to sustain current food demands (UN, 2021). Food waste incurs not only loss of resources, but it also has considerable environmental impacts due to multiple processes involved in the life cycle (Tonini, Albizzati, & Astrup, 2018a). When food goes to landfills, it decomposes and produces carbon dioxide and methane - greenhouse gases. Methane is a potent greenhouse gas that traps heat and further adds to the issue of climate change (Environmental Protection Agency, 2021a). According to a recent World Wildlife Fund (WWF) and Tesco report, food waste contributes to approximately 10% of all greenhouse gas emissions (WWF, 2021b). Almost six to eight per cent of human-caused greenhouse gas emissions could be reduced by putting an end to food waste, as in the United States alone, there is a production of

32.6 million cars' worth of greenhouse gas emissions by food waste (WWF, 2021a). From an environmental perspective, food waste is an extremely inefficient use of resources and there is a big environmental cost to pay for food from which humans derive little to no use (Lipinski, 2015).

The scale of food waste and its impacts may have been overlooked but “food waste reduction offers multi-faceted wins for people and planet, improving food security, addressing climate change, saving money and reducing pressure on land, water, biodiversity and waste management systems” (UNEP, 2021, p. 7). Sustainable management of food is imperative to reduce food waste and its associated impacts over the complete life cycle of food, starting with the use of natural resources, productions, sales, consumption, and final disposal (United States Environmental Protection Agency, 2021). Reducing global food waste was thus one priority included in the Sustainable Development Goals (SDG) under *The 2030 Agenda for Sustainable Development* by the United Nations (UN) member states in 2015 (UN, 2015). SDG 12.3.1(b) specifically aims at halving per capita global food waste at retail and consumer levels by 2030 (UNEP, 2021). Through the systematic approach of the sustainable management of food, many food waste impacts can be mitigated, including those on the environment (USEPA, 2021).

The concept of sustainable development and sustainability has grown and come a long way since it was first defined in 1987 by the Brundtland Commission (formally the World Commission on Environment and Development), as ‘development that meets the need of the present without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development, 1987). The role of education in the context of sustainable development was given an important boost when the United Nations General Assembly declared the United Nations Decade on Education for Sustainable Development from 2005 to 2014 (UN, 2005). The decade helped in focussing global attention on the fact that education is a crucial tool for achieving sustainable development (Takemoto, 2011). Education can be transformative in changing people’s behaviour and attitudes, and can encourage them to adopt a sustainable lifestyle (Takemoto, 2011). Education in general, and Environmental Education (EE)/ Education for Sustainability (EfS) in particular, were seen as a fundamental element of sustainable development initiatives.

Notwithstanding the two different terms, the general aims of Environmental Education or Education for Sustainability have been to involve students and help them take interest in environmental matters of the world (Tilbury, 1995). There are three key approaches to education in this field- education about the environment, education in the environment, and education for the environment. An integration of these three approaches may help in achieving the goals of reducing food waste via a learning programme that includes developing environmental awareness, knowledge, values, responsibility and action (Tilbury, 1995). An action is targeted at a change, at solving a problem and can be indirect or direct (Jensen, 2002). These approaches aim to improve literacy towards the environment.

The concept of Environmental Literacy (EL) has been advocated as helpful for achieving more sustainable lifestyles. Environmental Literacy has been variously defined but in this thesis the definition of the North American Association for Environmental Education (NAAEE) has been used. The NAAEE has defined an environmentally literate person as someone who makes informed decisions concerning the environment and is willing to act on these decisions to improve the well-being of other individuals and societies (Hollweg et al., 2011). Environmental Literacy was seen to have four components- knowledge, a set of affective and cognitive dispositions, a set of cognitive skills and abilities, and the appropriate behavioural strategies to apply such knowledge (Hollweg et al., 2011). Environmental Literacy is thus more than comprehending, it is a demonstration of capabilities and appropriate behaviours.

I feel that to alleviate food waste, food literacy should be an integral element of Environmental Literacy. Therefore, I explored food literacy in its present widely used context and found that the most cited definition of food literacy explains it as:-

the scaffolding that empowers individuals, households, communities, or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare, and eat food to meet needs and determine intake (Vidgen & Gallegos, 2011, p. 54).

I found that most of the research work about food literacy has focussed on the food and nutrition aspect of food (Bellotti, 2010; Cullen, Hatch, Martin, Higgins, & Sheppard, 2015; Howard &

Brichta, 2013; Palumbo, 2015; Pendergast & Dewhurst, 2012; Vaitkeviciute, Ball, & N., 2015; Vidgen, 2016). I could not find the inclusion of food waste under the broader concept of food literacy and decided that I should propose Food Waste Literacy (FWL) as a new form of literacy. Moreover, my reading on the issue of food waste and my personal experiences suggested to me that an awareness about food waste at the consumer level can be created, which can in turn lead to changes in attitudes, values, dispositions and behaviours (Grandhi & Singh, 2015). School curriculum has an important role to play in developing awareness about the needs of the community or environmental issues. Therefore, I decided to explore the position of food waste in the context of *The New Zealand Curriculum*, which supports schools in developing their own curriculum in response to the needs of their students and community (Ministry of Education, 2017). My study reported here, explores the present status of Food Waste Literacy of intermediate level students in a New Zealand school, and how it could be developed with an intervention which could help students in making better decisions and taking action around food waste.

1.3 Personal journey of the researcher

I am a biology graduate and environmental science postgraduate. I have taught science in schools in India since 1995. I have taught in diverse and uniquely isolated places in India and was intrigued by the environmental issues faced by the local population in each area. In my various experiences in India, I witnessed both extreme food shortage and equally extreme food waste. India is a diverse country in many contexts. In the context of food, there is severe food shortage in remote parts of the country while the city dwellers are habitual food wasters. I considered food waste to be unconscionable when there were millions of people starving in the country. Based on my previous personal experiences, I felt that one of the ways to tackle this issue could be through education focussed on children. Education is a tool to develop thinking and behaviour, and specifically environmental education is appropriate as it addresses both environmental and social issues. Children can be empowered with an outlook that focusses on the issues and problems around them and finding their solutions. They can therefore be the agents of social change in any society. There was a need to improve Food Waste Literacy amongst school children. This calls for an education which develops an understanding of the cause of the problem and teaches the skills to take actions for the solution. There is a need to learn and understand about this relatively unexplored component of food literacy which is food

waste. Consequently, I decided to study the significance of creating a specific kind of environmental literacy among students to address the issue of food waste.

When I started exploring about food waste issues in late 2016, I found that in New Zealand awareness about food waste, and therefore about food rescue as one of its solutions, was on the rise. I was fascinated to learn that there were many voluntary organizations which were actively involved in rescuing wasted food and creating awareness among the consumers. Kaivolution Food Rescue, KiwiHarvest, Kaibosh Food Rescue, Fair food, Just Zilch, Waiwaste, Kiwi Community Assistance, Kai Rescue Nelson-Tasman, 0800 Hungry and Food Share were some of the organizations working in the field of food rescue in New Zealand. Some of these services were rescuing food that would otherwise have been wasted from supermarkets like Countdown and big bakeries and distributing it to local needy communities. Goodneighbour, a voluntary organization working towards the betterment of neighbourhoods, has been undertaking food rescue work since 2014, in the Bay of Plenty (Good Neighbour Food Rescue, 2018). There are innovators and entrepreneurs like Mr. Ash Sharma, who created Freshkeeper, who have developed products which help in reducing decay of fruits and vegetable, thus reducing food waste, both at large supermarkets and at home (Fresh, 2018). Even supermarket chains are proactive towards the issue. According to Foodstuffs NZ, supermarkets like New World and PaknSave have been a part of the waste minimisation programme and have been donating food which is not able to be sold but is still safe to be eaten (Foodstuffs NZ, 2018). Combatting food waste has continued to remain in focus and a wide range of experts and stakeholders are playing a vital part in this. Additionally, a number of government and intergovernmental initiatives are underway to tackle food waste in New Zealand, as reported by the Office of the Prime Minister's Chief Science Advisor (OPMCSA, 2022).

Moreover, I found that in New Zealand, public surveys were also being carried out to create an awareness about food waste issue in the country. A ‘RaboDirect’ survey, carried out by RaboBank, New Zealand, found that New Zealanders, throw away almost \$2 billion worth of food a year (Clayton, 2017). The survey, which was carried out on 1003 people in 2017, found that 80 per cent of people did not like to waste food but 94 per cent did report wasting food. The survey revealed some startling statistics like, each household wasted about \$1071 worth of food per year, which added up to \$1.8 billion for the country as a whole. New Zealanders

are wasting even more food now than in 2017 with the estimated value of food waste \$1520 per household, which equates to \$3.1 billion of wasted food (Rabobank, 2022). Love Food Hate Waste (LFHW) New Zealand is an organization being supported by 60 councils from around New Zealand in association with WasteMINZ and Wanaka Waste busters. According to it, food waste has been a major issue in New Zealand, as each Kiwi household was throwing away about 79 kgs of edible food each year (Love Food Hate Waste, 2018) and this cost approximately \$563 per year per family. It amounted to 122,547 tonnes of food waste per year. Thus, the largest percentage of food was being wasted at the household level. Love Food Hate Waste New Zealand reported many reasons for food waste in the country, with two of these being the habits of not eating leftovers, and improper storage of food.

In comparison, in India, I found that there were not-for-profit organizations, working towards the cause of food rescue in India, although the number of such organizations was less than in New Zealand. The Indian Food Banking Network (IFBN), a not-for-profit organization, has been bringing together many Non-Government-Organizations (NGOs) and other stakeholders to establish food banks (India FoodBanking Network, 2018). No Food Waste, Annakshetra, Feeding India, Robinhood Army and Roti Bank were some of the NGOs working towards food rescue, at that time. No information could be found showing the involvement of the local or the national government toward this cause. Based on a literature review up to 2017, I found that not much research and policy work had been done on food waste and food rescue work in India. All these inputs guided my belief that New Zealand was the right place to carry out this study. Consequently, I decided to assess the present understanding of school students of New Zealand towards food waste and how to further develop their Food Waste Literacy with the help of an intervention. However, I was aware of my challenges as an Indian researcher in New Zealand which included my accent of English (being my second language) and my unfamiliarity with *The New Zealand Curriculum* and the schooling system.

The New Zealand education system spans three levels- early childhood education (from birth to school entry age), primary and secondary school education (from 5 to 17 years of age), and tertiary education (higher and vocational education). Years 7 and 8 students form either a part of primary schools or separate intermediate schools. There are two general kinds of schools which differ by the medium of instruction. One kind has English as their medium of instruction.

The other has ‘te reo Māori’ as the medium of instruction and students are taught all or some curriculum through Māori. There are also some English medium schools which have a Māori immersion unit within them where students learn both through English as well as ‘te reo Māori.’ In terms of policy, there is *The New Zealand Curriculum* (NZC) which is followed by the schools that teach in English language while schools using the Māori medium of instruction use the Te Marautanga o Aotearoa (a curriculum based on Māori values) (Ministry of Education, 2018b). I am not providing more details about the Te Marautanga o Aotearoa curriculum, as my study was not done in a Māori medium school.

I decided to conduct my study on Year 7 students as the students in the intermediate years of schooling are young adolescents, generally aged between 11 to 13 years old. It is a transitional phase for the students between primary and secondary school. These years are important and filled with rapid physical changes, cognitive development and increasing analytic capability; a time of self-exploration and increasing independence, and active participation in a more complex social universe (Banati & Lansford, 2018; Kipke, 1999). Generally, intermediate schools in New Zealand are run in the same manner as primary schools, as there is a home room teacher who is responsible for the core subjects’ teaching. There are specialized teachers for different subjects. Students are exposed to all learning areas of *The New Zealand Curriculum*. At the intermediate level of schooling, students are challenged to develop curious and analytical minds and dispositions, in preparation for the next stage of schooling that involves independent learning (Kiwi Families, 2018). Thus, I felt that this could be the right stage to impart Food Waste Literacy to the students with the help of a curriculum-based intervention.

The New Zealand Ministry of Education states that *The New Zealand Curriculum* has an overall vision and a blend of principles, values, key competencies and learning areas. The part of the vision of interest to my study is - students to be actively involved in the social, cultural, and environmental well-being of New Zealand and develop into good citizens (Ministry of Education, 2007). *The New Zealand Curriculum* is guided by a set of principles which put students at the centre of teaching and learning. These principles engage students in a curriculum which affirms New Zealand’s unique identity. I found that the principles relevant to this study are centred around cultural diversity, learning to learn, community engagement, and focus for

the future (Ministry of Education, 2007). The principles of cultural diversity and community engagement inculcate the spirit of citizenship amongst students, which are important for inclusion of multiple viewpoints, and for acquiring a sense of individual and community responsibilities. The values which the students are encouraged to learn include equity, community and participation, and ecological sustainability. Hence I feel that Food Waste Literacy can play an important role in achieving the vision of lifelong learners relating to others. Imparting Food Waste Literacy would necessarily be guided by the principle of community engagement. It would also contribute to enhancing many of the other values underlined in *The New Zealand Curriculum*. For example, by learning to deal with overbuying of food they can imbibe the value of equity. Food Waste Literacy may also promote community participation and form an essential component of training in ecological sustainability.

The values, the principles and the overall aim of *The New Zealand Curriculum* are translated for the students through the key competencies. There are five key competencies which find a place in the curriculum. They are thinking, managing self, relating to others, using language, symbols, and texts, and participating and contributing. Participating and contributing is in fact education for democratic citizenship (Ministry of Education, 2014). Thus, Food Waste Literacy can be an effective means of relating to others, and for participating and contributing to communities. Students can relate to others that on the one hand, food meant for human consumption is wasted and on the other a large percentage of the global population suffers from hunger and food insecurity.

1.4 Statement and significance of the study

1.4.1 Statement of the Study

The purpose of this study was to investigate and develop Food Waste Literacy of Year 7 New Zealand students. The study focused on the following research questions:

- RQ 1. What is the Food Waste Literacy of Year 7 students in a New Zealand school?
- RQ 2. What kind of intervention might be designed and implemented to engage Year 7 students in developing Food Waste Literacy?
- RQ 3. How does an intervention activate Year 7 students' inquiry and decision making in Food Waste Literacy?

This study is informed by a conceptual framework of Food Waste Literacy under the ambit of environmental literacy including environmental knowledge, environmental attitude and values, and environmental behaviour. The study's philosophical foundation is interpretivism which is a 'people-centred' approach, with an emphasis on data collected which is qualitative in nature and rich and unique (Brundrett & Rhodes, 2013). Interpretivists believe in generation, construction and discovery of data for gathering knowledge (Erickson, 2018). Interpretivism is subjectively driven and can have a holistic perspective which was important in this study. The study used social constructivism theory to explore and explain the outcome of an intervention which is allied to interpretivism, where students may construct their subjective meanings of their socially- derived experiences (Creswell, 2013) of food waste.

In this study, a convergent parallel mixed method design (Creswell & Creswell, 2018) was used in which qualitative and quantitative data were collected in parallel, analysed separately and then combined to produce conclusions. The qualitative data allowed for an in-depth exploration of the level of knowledge, attitude and values, and reported behaviour of the students towards food waste. For this, focus group interviews were carried out with the students of Year 7 in one New Zealand school, and open-ended questions were included in the survey questionnaire. The qualitative data were analysed using thematic analysis techniques (Clarke & Braun, 2017). The quantitative data were collected using a survey questionnaire with the same students and were analysed using descriptive statistics.

1.4.2 Significance of the Study

As mentioned above, studies on Food Waste Literacy have been difficult to find. This novel study therefore contributes to knowledge of Food Literacy, especially in the context of adolescent children. This study could help create connections between Food Literacy and Environmental Literacy. Moreover, this study helps in building an understanding of what is Food Waste Literacy and highlights the gap that exists for it in the broader concept of food literacy.

From a pedagogical perspective, the study helps understand that interventions can be designed to develop Food Waste Literacy among students to add to the gamut of solutions for improving the food waste issue. From *The New Zealand Curriculum* perspective, the study informs

teachers about the inclusion of Food Waste Literacy as an integrated component across different learning areas. Other stakeholders may also draw on the findings of this study, for instance, curriculum decision policy makers and teachers from India and other countries. The study also makes an important observation that teachers are instrumental in developing students' Environmental Literacy and specifically Food Waste Literacy. From a theoretical perspective, this study is significant as it involved the concept of Environmental Literacy and social constructivism to investigate and develop students' Food Waste Literacy.

1.5 Overview of thesis chapters

This thesis is comprised of seven chapters. Synopses of the remaining chapters are outlined below.

Chapter 2 - This chapter presents the literature relevant to this study, with a detailed examination of topics which would provide further insight into food waste, environmental literacy and Food Waste Literacy. This begins with the issue of food waste, its definition, and scale in the global context and in the New Zealand context; reasons for food waste, its significance and its policies; conceptualising literacy as, multiliteracies, including food literacy; food literacy and its linkages to sustainability; environmental and sustainability education, environmental literacy; the New Zealand education system and environmental education; inquiry-based learning; and intermediate schools and environmental and sustainability education in New Zealand. The chapter concludes with the conceptual framework underpinning this study.

Chapter 3 - This chapter presents the methodology used in this study. Various paradigms which may support educational research are discussed followed by the research approach and design used in the study. Next, I discuss the data analysis methods for this mixed-methods study. The chapter concludes with discussion around reliability and validity of the study, and ethical considerations of this study.

Chapter 4 - This is the first of the three findings' chapters. This chapter presents the findings of the first research question on the evaluation of the current Food Waste Literacy status of Year 7 New Zealand students.

Chapter 5 - This is the second of the three findings' chapters. This chapter presents the data for the second research question about the kind of intervention which can be designed to develop students' Food Waste Literacy.

Chapter 6 - This is the final findings' chapter which presents the evaluation of the intervention in activating students' inquiry and decision making about Food Waste Literacy.

Chapter 7 - This is the final chapter which discusses the findings, draws conclusions and limitations of this study, and presents some recommendations for future research and practice.

Chapter 2 Literature Review

2.1 Chapter outline

This chapter presents a review of literature which is relevant to this study, and which paves the way for investigating and developing Food Waste Literacy (FWL) among intermediate students. This chapter begins with the problem of food waste in the world, wherein food waste has been defined, followed by the scale and the significance of food waste. The scale of food waste is reviewed in the global context, and subsequently in the New Zealand context. Thereafter, I present a review of literature about the significance of food waste and food waste policies in some countries relevant to this research. Since the focus of this study is on developing Food Waste Literacy (FWL) among intermediate students, the following sections discuss the evolving link between literacy, food literacy, food waste, food citizenship and sustainability, and Food Waste Literacy and sustainability. A section on Food Waste Literacy and sustainability presents the connections and linkages between food waste, sustainability, environmental education and environmental literacy. Since this study explores and develops Food Waste Literacy among intermediate level students in the New Zealand school system, this chapter provides a brief review of the New Zealand education system, especially the intermediate schools and the sustainability education therein. The chapter concludes with summaries of the main ideas presented in the literature review, and the conceptual framework used in the study based on the literature review.

2.2 Problem of food waste

2.2.1 Defining food waste

According to a study of the Food and Agricultural Organization of the United Nations (FAO), food loss is the throwing away of food that is safe for human consumption, somewhere along the Food Supply Chain (FSC) process, from the initial production level to the final household level (Gustavsson et al., 2011, p. 18). Food loss usually takes place at the production, storage, processing, and distribution stages in the FSC and it is typically the unintended result of some agricultural process or some technical limitation down the FSC (Lipinski, 2013). However, as the focus of my research is not aimed at food loss which takes place in the above-mentioned stages of the FSC, I will explore food loss at the end of the FSC which is differentiated as food waste. Food waste has been defined as food loss occurring at the end of the Food Supply Chain, mainly at the retail and the consumer level, which relates to retailers' and consumers' behaviour

(Parfitt, Barthel, & Macnaughton, 2010). Most recently, the FAO's report "*The State of Food and Agriculture*" (SOFA), also referred to food waste as "the decrease in the quantity and quality of food resulting from decisions and actions by retailers, food service providers and consumers" (FAO, 2021c). Further clarity about explaining food waste, has been offered by the United Nations Environment Programme (UNEP). According to the UNEP:

Food waste refers to food that completes the food supply chain up to a final product, of good quality and fit for consumption, but still does not get consumed because it is discarded, whether or not after it is left to spoil or expire. Food waste typically (but not exclusively) takes place at retail and consumption stages in the food supply chain. (UNEP, 2019).

Therefore, food waste refers to food that is of good quality and fit for consumption but does not get consumed. It typically takes place at the retail and the consumption stages and is usually the result of negligence or a conscious decision to throw food away (Lipinski, 2013).

While food loss occurs at different levels of the FSC, I examined food waste at the consumer level, particularly focussing on the areas of food loss most relevant to the daily lives of students at the intermediate level of schooling, and exploring and developing their knowledge, attitudes, and behaviour towards food waste.

2.2.2 Scale of food waste

2.2.2.1 Global food waste

Food waste is a global issue, affecting the developed as well as the developing countries. To put that in perspective, the Food and Agricultural Organisation (FAO) in 2011 stated that globally, one third of all the food produced for human consumption is either lost or discarded every year, of which fruit and vegetables are the largest group of food items wasted. It amounted to almost 1.3 billion tons of food per year (Gustavsson et al., 2011). Moreover, about 30 per cent of cereals, 50 per cent of root crops, fruit and vegetables, and 20 per cent of meat and dairy products were wasted globally annually (FAO, 2011). This seminal report by the FAO is cited in most published reports and research statistics, but it does not describe the amount of food wasted at each level of the food supply chain. It is currently one of the most exhaustive and reliable sources of information about food waste. The FAO report also stated

that on a per capita basis, much more food is being wasted in the industrialized world than in the developing countries. The report estimated that the per capita food waste by consumers in Europe and North America was 95-115 kg/year, while in sub-Saharan Africa and South/Southeast Asia it was 6-11 kg/year. Moreover, food waste at the consumer level in industrialized countries was estimated at 222 million tons, which was almost as high as the total net food production in sub-Saharan Africa, which was about 230 million tons. According to Bagherzadeh (2014), the discussion of food waste has become more important, ever since the FAO published the details of food waste and its impact on countries. According to the *Food Waste Index Report 2021* prepared by the United Nations Environment Programme (UNEP), 17 per cent of food available at retail, food service and consumer level is thrown away (UNEP, 2021). The *Food Waste Index Report 2021* notes that there is a lack of robust data on food waste across the globe and there are gaps in national estimates of food waste and food loss.

As New Zealand has a lot in common with the United Kingdom (UK), I explored food waste issues in the UK. It has been estimated that in the UK, 10 million tonnes of food and drink are wasted each year, 60 per cent of which is avoidable (House of Commons & Environment Food and Rural Affairs Committee, 2017). The Committee noted that modelling suggested that, without further intervention, food waste may increase by a further 1.1 million tonnes by 2025.

Food waste in Australia has also been described as a major problem which costs the economy around AU\$20 billion each year (Australian Government, 2021b). According to the Department of Agriculture, Water and the Environment, each year the country wastes around 7.3 million tonnes of food, which is equivalent to 300 kg per person, or one in five bags of groceries. Moreover, it also accounts for more than five per cent of Australia's greenhouse gas emissions (Australian Government, 2021b). The quantity of food waste seems to be growing through the years as in another Australian study, which was conducted to understand the significance of food waste, the authors had concluded that in 2008, Australia wasted AU\$5.7 billion worth of food (Reutter, Lant, Reynolds, & Lane, 2017).

Even the USA, one of the most powerful nations, is facing a big challenge of food waste. According to the United States Department of Agriculture (USDA) (USDA, 2018), 30 to 40

per cent of food is lost during the food supply process in the USA. This amounted to about US\$161 billion worth of food in 2010 (USDA, 2018). According to a similar report of the Natural Resources Defence Council (NRDC), in 2012, America lost nearly 40 per cent of its food from farm to fork to landfill (NRDC, 2017).

The food waste problem occurs not only in UK, Australia and North America, it occurs throughout the western world (Silvennoinen, Katajajuuri, Hartikainen, Heikkilä, & Reinikainen, 2014). In a study conducted in 2018 (von Massow et al., 2019) in Canada, food waste behaviour of 94 families with small children was researched. The research findings suggested that the average Canadian household produced about 2.98 kg of avoidable food waste per week. The food waste was assessed in terms of economic losses, nutritional losses, and environmental impacts. The aim of the study was to help in policymaking and in educational and behavioural-change interventions about food waste. The study acknowledged that the generalizability of the research may not extend to other contexts and advocated for similar research in other areas to generate information about the state of household food waste. In a similar Finnish study, 380 households were observed for their avoidable food waste, over a period of two weeks (Silvennoinen et al., 2014). It was found that Finnish people were wasting about 23 kg of food per capita, 63 kg per household, and in total about 120 million kg/year.

The country with the largest population in the world, China, does not have a national statistical system for food waste and hence there is no official figure for food waste (Li, Wang, Liu, & Cheng, 2021) . However, it seems likely that a food waste problem affects all parts of the inhabited world, in some way or the other (Reynolds, Soma, Spring, & Lazell, 2020).

2.2.2.2 Food waste in New Zealand

Research about food waste in New Zealand has been scant but has gained momentum in the last few years. As indicated by one study, *New Zealand's Food Waste* (2015), there had been very few quantitative and qualitative metrics of food waste behaviours, tonnages, and impacts, until 2014 (Reynolds et al., 2016). This study made use of top-down direct-inputs waste-estimation methodology, to assess the food waste in New Zealand for the period of 2011.

Fourteen food waste categories were created, and the food waste data were collected from the Ministry for the Environment's monthly landfill data. The research suggested that New Zealand households produced about 224,000 tonnes of food waste in 2011, while industrial food waste was about 103,000 tonnes. This food value was estimated at about NZ\$568 million, with households' waste worth NZ\$369 million and industrial waste NZ\$199 million. In relation to the population of New Zealand in 2011, which was about 4.4 million, it rounded up to NZ\$131 per person per year. Moreover, New Zealand food waste represented about 42×10^6 tonnes of CO₂-e per year with 23×10^6 tonnes of CO₂-e from household food waste alone. (CO₂-e or carbon dioxide equivalent is a standard unit for measuring greenhouse gas emissions). One of the limitations of the research was that only the food waste that was 'formally' disposed of, was accounted for in the research. The research suggested that further analysis of food waste data could be undertaken with a special focus on economic and environmental food waste interventions. However, there was no suggestion of creating public awareness towards food waste.

Food waste generated by households has recently been estimated in 2021 by Rabobank, New Zealand, which reported that New Zealanders are now wasting less food than in 2019 with the estimated percentage of food waste falling to 8.6 per cent from 10.2 per cent in 2019 (Rabobank New Zealand, 2021). However, New Zealanders are still wasting NZ\$1,259 worth of food per household which amounts to NZ\$2.4 billion of food waste per year. There are further interesting findings in this report which are mentioned, such as, almost 42 per cent of New Zealanders threw away unopened or untried food, and generation Y and Z (younger New Zealanders) waste a significantly higher proportion of their household food than other generations (Rabobank New Zealand, 2021).

Household food waste was also studied by WasteMINZ, the largest representative body of the waste and resource recovery sectors in New Zealand. In 2013, WasteMINZ , launched the National Food Waste Prevention Project (WasteMINZ, 2021) in partnership with the University of Otago, New Zealand. The project was aimed at quantifying food waste along various stages of the food supply chain in New Zealand. The project was divided into three stages - household food waste (2013), supermarket food waste (2018) and café and restaurant food waste (2018). The initial task of the project was to calculate household food waste

nationwide. The research results were published in 2015 in the *New Zealand Food Waste Audit* (Waste Not Consulting, 2015). The main research method was to collect household waste by carrying out audits of household waste bins collected through kerbside refuse collections. 1402 household bins were randomly audited across 12 council regions throughout New Zealand. The food waste was sorted into 16 food groups and labelled ‘avoidable’, ‘potentially avoidable’ and ‘non-avoidable’. Across all 12 council regions, a total of 25,330 food samples were weighed, categorised, and audited. Finally, the value of ‘avoidable’ wasted food items was listed as NZ\$872 million or 122,547 tonnes of food. Based on the combined results of all food waste audits, of the 2.84 kg of food waste per household per week, 54 per cent was categorised as ‘avoidable’ food waste, 12 per cent as ‘potentially avoidable’ food waste, and 35 per cent as ‘non-avoidable’ food waste.

The second part of the research was a nationally representative online survey, in which the attitudes and behaviours of 1,365 households towards food waste were surveyed (WasteMINZ, 2014). This indicated that, on average, each household reported throwing out about 2.8 kg of food waste per week, out of which 1.3 kg was deemed avoidable waste. Households with children under 15 years of age produced more household food waste and more ‘avoidable’ food waste, as compared to households with no children. The higher the family income, the more food waste was generated (WasteMINZ, 2014). The report concluded that high food wasters may be viewing their food wastage as normal and not believe that change in behaviour is necessary. However, this audit did not cover industrial and commercial food waste, or food waste disposed of via non-formal disposal routes like backyard composting, feeding to animals or food rescue (Reynolds et al., 2016). This survey thus left New Zealand with an important data gap in terms of quantification of food waste.

Food waste generated by households in New Zealand was also studied by RaboBank, New Zealand in a ‘RaboDirect’ survey in 2016. The survey found that New Zealanders reported throwing away almost NZ\$2 billion worth of food a year (Rabobank, 2017). 1003 people participated in the survey, and it was found that 80 per cent of people did not like to waste food, but 94 per cent did waste food. This survey finding was an interesting indicator about the participants’ attitude about food waste. It signalled that 94 per cent of the participants did waste food despite most of the participants expressing that they did not like to waste food. Moreover,

the survey indicated that each household on average wasted about an eighth of their weekly food purchases which added up to NZ\$1071 worth of food per household per year (Clayton, 2017).

Household food waste and ways of reducing it was also researched by Harriet Parr, in her Master's research (Parr, 2013). A case study approach was followed to understand food waste behaviour and perceptions and how far these behaviours are influenced by the information provided on food rescue websites. Parr's study suggested that food waste could be reduced with appropriate education of households. In another study by Tucker and Farrelly (2016), a survey was carried out about consumers' food practices from purchase, to plate, to disposal, and the environmental implications of these practices. This survey was carried out with 147 participants in Palmerston North in New Zealand. The rateable property values of each selected urban area were a selection criterion, to capture wide socio-demographics. The findings suggested some of the barriers and opportunities towards the prevention of food waste in New Zealand. The results indicated that the amount of food waste was mostly directly dependent on the number of household members and especially the number of younger people. Also, it was the youngest people in the survey, in the age group of 18-24 years old, who were found to be the least concerned about the environmental impact of food waste. Tucker and Farrelly suggested the need for addressing the issue of food waste by using education initiatives across the New Zealand population. However, they made no specific suggestions for educating the younger population.

Food waste at supermarkets in New Zealand was also estimated and analysed under the second part of the WasteMINZ project. Under this project, Goodman-Smith of the University of Otago, carried out a quantitative and qualitative study of retail food waste in New Zealand (Goodman-Smith, 2018). She estimated the amount of food waste at 13 kg per capita per year, including diverted product, which is food not sold or utilized at the retail level. In her analysis, a few motivators were identified which helped the retail workers to reduce food waste. Some of the motivators which seemed effective were caring for the community, protecting the environment, and doing the right things. She also identified training and education as one of the key barriers to food waste reduction and aimed the study at being utilised as baseline data for future retail food waste studies in New Zealand.

Food waste in the café and restaurant sector in New Zealand has also been researched, especially under the third part of the WasteMINZ project. It involved two studies in partnership with the University of Otago, New Zealand (WasteMINZ, 2021). These studies (Chisnall, 2018; Jones, 2018) were aimed at investigating and reporting food waste taking place in those sites in New Zealand. Chisnall (2018) recommended customer education initiatives to target customer plate waste behaviour in these places, while Jones (2018) concluded that to obtain better estimates of food waste, on-site waste audits should be used rather than self-reported measures. Jones' research also conveyed that those businesses seemed unaware of their avoidable food waste.

Finally, hospitals are another source of food waste and this was researched in a 2013 study involving hospitals wasting food while processing and before food was consumed by patients, in three New Zealand foodservice facilities (Goonan, Mirosa, & Spence, 2014). Data were collected by analysing existing documents, observing the day-to-day food waste generation practices like food preparation and food services, focus group sessions involving 22 people directly involved in food preparation and handling, and individual interviews with foodservice personnel. The results of this research showed that over a period of two weeks of the research, 350 meals were wasted out of 1,752 meals prepared in a day, in one hospital. The other hospital wasted 200 meals out of a total of 2,420 meals produced per day. An interesting feature of the research was the observation of the attitudes and perceptions of the foodservice personnel about food waste. Personnel who were working in this role for a long time had become indifferent to food waste, unlike the newer recruits. The research concluded that food waste generation was influenced by the attitudes of foodservice personnel and that generating sustainable behaviour in the workforce could lead to more sustainability of the global food system.

This review has indicated that significant amounts of food waste is happening globally and in New Zealand at several levels. It also appears that education could be effective in reducing food waste. For education to be effective, an understanding of why food waste happens at the various stages and especially at the consumer level, is critical. The next section presents analysis of the literature about the reasons for food waste.

2.2.3 Reasons for food waste

The reasons why people might waste food have been studied and theorised by research in various countries. Broadly, the research on household food waste and reasons for that have highlighted some common reasons like food waste related beliefs, overbuying of food, not buying imperfect looking fruits and vegetables, over preparation of food, discarding leftovers and not understanding food labels like ‘use by’ and ‘best by.’

Food waste-related beliefs, attitudes, and behaviours at household level in Canada were researched in a study (Parizeau, von Massow, & Martin, 2015) involving 68 households. The study found multiple relationships between food waste in households, food shopping behaviour, food preparation practices and food related attitudes and beliefs. Most of the respondents were women and almost 65 per cent of the respondents agreed that they could reduce the food waste. The researchers indicated that there are cultural, social, and economic factors which may influence food waste practices, but they also suggested that education and skill-building could help in reducing household food waste. Education against wasting food was also recommended in a study on Italian youth (Principato, Secondi, & Pratesi, 2015) which was aimed at identifying factors that influence changes in behaviour concerning food waste.

Cultural attitudes leading to food waste were also indicated in a study undertaken by the European Commission (EU) in 2009 (Monier et al., 2010). The overall aim of the study was to investigate the causes of food waste, in the European Union (EU). The findings suggested lesser awareness and cultural attitudes, as the main causes of food waste, especially at the household and catering levels. Almost 42 per cent of 89 million tonnes of food waste produced annually in the EU was contributed by households. Another 39 per cent and 14 per cent of food waste were contributed by manufacturing and food services, respectively. The study suggested making use of more reliable food waste data reporting, as the data available was insufficient and unreliable. Most importantly, the study suggested that there was a need for increasing the public awareness towards food waste, and for bringing a long-term behavioural change to reduce food waste, especially at the household level.

Several reasons for food waste including, spoilage, plate leftovers, expiry of best before or use by date, and preparing more food than needed, were indicated in a Finnish study (Silvennoinen et al., 2014). This study suggested that knowledge about food waste could help in the development of new practices to decrease waste. Non-use of food or surplus food purchases not being consumed, as reasons of food waste were also reported in a study which was carried out to explore household food waste in Italy (Di Talia, Simeone, & Scarpato, 2019). This research was however, primarily, focussed in a rural area in Italy to assess the level of knowledge of the economic, environmental, and ethical consequences of food waste by consumers residing in such rural areas (Di Talia et al., 2019). Among other findings, the researchers found out that even in that rural area, the reasons for food waste were non-use of food or surplus food purchases which were ultimately not being consumed. Household food waste because of non-use of food or surplus food purchases not being consumed, were also reported in a study in an emerging country like Uruguay (Aschemann-Witzel, Giménez, & Ares, 2019), Serbia and Poland (Djekic, Miloradovic, Djekic, & Tomasevic, 2019; Kowalewska & Kołajtis-Dolowy, 2018).

Inadequate understanding of food labels which leads to food waste at consumer level was also emphasised in a Belgian study (Boxstael, Devlieghere, Berkvens, Vermeulen, & Uyttendaele, 2014) and in an EU 2009 study (Monier et al., 2010). Both these studies recommended promoting better understanding of the various food labels like ‘best before’ and ‘use by’ coherently to consumers, as lack of clarity about these date labels appeared to lead to large amounts of food waste.

It is clear from the analysis of the literature so far that food waste is a problem, and the next section examines how significant it is.

2.2.4 Significance of food waste

Reducing food waste in highly developed countries may improve availability of food to undernourished people in less developed countries, but it may also reduce competition for limited natural resources like land, water, and biodiversity. Food waste incurs food insecurity, loss of resources and appreciable environmental impact. Food waste deprives millions of

underfed people of food, around the world. A large amount of edible food is thrown away every day. Eight hundred and fifteen million people are undernourished, globally (UNRIC, 2018). The number of undernourished people is expected to rise with the population growing by 2 billion by 2050 (WHO, 2017). Also, almost 13 per cent of the population in developing countries has been rated as undernourished, and two-thirds of the population in Asia remains hungry (WHO, 2017). Almost 15.8 million households in United States are estimated to be food insecure, which is about 13 per cent of households (Global Hunger Relief, 2018). It would be possible to feed all those food-insecure people by reducing food waste by 15 per cent globally and to feed an additional one billion people by reducing the food waste by half in the United States (NRDC, 2017).

New Zealand had 100,000 severely food-insecure people in 2015-2017, which amounted to 3 per cent of the total population at the time (FAO, 2018b). According to the Ministry of Education in New Zealand, in New Zealand, around one in five children live in households that struggle to provide food to their children (New Zealand Ministry of Education, 2021). In 2019, the New Zealand Government announced a two-year initiative to provide free school lunch (*Ka Ora, Ka Ako*) to Year 1-8 (primary and intermediate aged) students, with high levels of social disadvantage. The Government expanded the *Ka Ora, Ka Ako* programme to more schools during the COVID-19 pandemic as food insecurity was affecting more households, which in turn impacts students' learning and well-being (New Zealand Ministry of Education, 2021). Unfortunately, according to a newspaper report thousands of these lunches are being left uneaten by students each week (O'Dwyer, 2021). This report also included that in Hamilton, the fourth most populous city in New Zealand (Hamilton i-SITE Visitor Information Centre, 2020), there can be up to 1500 lunches which are left over from city schools each day. It is a concerning behaviour when it is known that among the communities in New Zealand, which are facing greater socio-economic barriers, 40% of parents run out of food sometimes or often (New Zealand Ministry of Education, 2021).

In the present food supply chain, vast amounts of resources are also used to get food from farm to table and these resources are in the form of embedded resources. According to the National Resources Defence Council (NRDC) these resources are largely used in the agricultural stage, which constitutes the most resource intensive stage of food production (NRDC, 2017). As

reported by the NRDC, about 16 per cent of the United States' energy, almost half of all U.S. land, and 67 per cent of the country's freshwater is used for producing food in the country (NRDC, 2017) and these resources are wasted if that food is never eaten. Food waste in the USA also leads to a waste of other resources like 18 per cent of all farming fertilizers and 19 per cent of all croplands (Gunders et al., 2017).

Uneaten food which is dumped in landfills is responsible for producing harmful methane gas, causing environmental pollution (Bagherzadeh et al., 2014). According to the U.S. Environmental Protection Agency (EPA), food is the single largest material to be put in landfills and the third largest contributor of human-related methane produced in the USA (EPA, 2021). According to a 2009 report by the European Union (EU), it was pointed out that food waste contributed to about 3 per cent of total EU greenhouse gas emissions in 2008 and reducing food waste would reduce the total greenhouse gases emissions in the EU (Monier et al., 2010). According to the FAO, uneaten food going to landfills was the third largest contributor of harmful methane gas worldwide, after USA and China, producing about 3.3 billion tonnes of greenhouse gases per year at that time (FAO, 2011). A more recent study by the Intergovernmental Panel on Climate Change (IPCC) estimated that eight to ten per cent of global greenhouse gas emissions are associated with food waste (Mbow et al., 2019), and ReFED, a national non-profit organisation to end food loss and food waste in the United States, recently estimated that food waste is creating 7.5 million tonnes of greenhouse gas emissions per year (ReFED, 2021).

It is clear from the above review that food waste incurs loss of resources and considerable environmental impacts due to the multiple processes involved in the life cycle of food (Tonini, Albizzati, & Astrup, 2018b). Consequently, reduction in food waste could reduce the number of undernourished people, could lead to a decrease in land and water utilisation, and in greenhouse gas emissions associated with food waste in landfills. The reduction in food waste may be possible in various ways and one positive step towards reducing food waste has been the recent rise in food rescue. The next section will review the literature about food rescue work being carried out globally and specifically in New Zealand, especially during the COVID-19 pandemic.

2.2.5 Food rescue work

2.2.5.1 Global food rescue

As food waste presents environmental problems, it also leads to ethical and economic dilemmas. Fortunately, businesses, non-profit organisations and donor groups have been proactive in tackling food waste. There are non-profit organisations in many countries which have been making efforts to address food waste. These organisations collect surplus food donations that would otherwise be wasted, from supermarkets, hotels, restaurants, grocery stores etc. The rescued food is then delivered to food insecure communities in the area. For instance, *FareShare*, UK's largest organisation that rescues and redistributes surplus food to charities and organisations, rescued 26,329 tonnes of food from 2019 to 2020 in the UK (UK Parliament, 2021). *Foodtank*, a non-profit organisation pushing for food system change, highlighted the operation of 21 food rescue organisations in Australia (Walla, 2019). In the context of New Zealand, there are over 20 food waste rescue groups like Kaivolution, Love Soup, Kiwi Harvest, Kaibosh and more which can be accessed via *Aotearoa Food Rescue Alliance members* (Love Food Hate Waste New Zealand, 2021).

Rescuing food had already been a global challenge due to various coordination, political and other hurdles but the COVID-19 pandemic has further disrupted the food rescue work in most of the countries. The pandemic has caused disruptions in national and regional food supply chains, with food producers and distributors experiencing widespread losses (FAO, 2021a). The pandemic has caused widespread food loss and added to the number of food insecure people, at the same time. In the United States, the *ReFED COVID-19 Food Waste Solutions Fund* was launched by *ReFED*, to rapidly scale food waste reduction and hunger relief efforts (ReFED, 2020). In 2020, the Canadian government launched a \$50 million *Surplus Food Rescue Programme* to help manage and redirect existing surpluses to organisations addressing food insecurity and to ensure that these surplus products are not wasted (Government of Canada, 2020b). This programme was designed to address urgent, high volume, highly perishable surplus products falling under meat and fish, horticulture and seafood. Second Harvest, a Canadian not-for-profit organisation was given the maximum grant to execute this programme in a cost effective and efficient approach (Government of Canada, 2020b).

There are various foodbanks in the United Kingdom which have been rescuing and redistributing donated food but the COVID-19 outbreak has made the rescue work difficult for these foodbanks (Greater London Authority, 2021). Under the leadership of the mayor of London, the London Food Strategy has been actively promoted in conjunction with the London Food Board, to rescue surplus food and make it accessible to people in need. There are various foodbanks like City Harvest, Independent Food Aid Network, the Felix Project, FareShare and the Trussell Trust which are supported under this scheme (Greater London Authority, 2021).

2.2.5.2 Food rescue work in New Zealand

In New Zealand, a long list of food rescue organisations can be drawn up which have been rescuing and redistributing food for a number of years (Love Food Hate Waste New Zealand, 2021). Moreover, many food banks have also been accepting food donations from supermarkets and stores to be used in food parcels to help those in need (Countdown, 2021). The need of food banks was felt acutely during the COVID-19 pandemic. In Auckland alone, a major city of New Zealand, there were 29 registered food banks during the initial impact of COVID-19 pandemic in August 2020 (Theunissen, 2020). To especially deal with food waste during the pandemic, the agriculture minister of New Zealand, in August 2020, announced an aid of NZ\$14.9 million to redirect food that would otherwise have been wasted, to those in need (New Zealand Government, 2020). This money was used to ensure that the vulnerable communities in New Zealand which were hit by COVID-19 had food on their tables. The Ministry of Social Development of New Zealand provided support to launch the Aotearoa Food Rescue Alliance (AFRA) in March 2021 (AFRA, 2021) to provide national support for local food rescue organisations to reduce waste and increase food security. The Alliance has 19 food rescue member organisations who rescue food from being wasted and redistributes food to people in need. The Alliance aims to prevent food from going to landfills and provides local, practical solutions to meet immediate hunger needs in the community (AFRA, 2021). The impact of COVID-19 pandemic on food waste has been far reaching globally and more food waste has been occurring at different stages of the food supply chain (Walsh, 2021). On the one hand, food rescue work became difficult because of the pandemic, while on the other, food banks saw an unprecedented increase in the demand for food (Walsh, 2021). In New Zealand, children have also been impacted by growing food insecurity as a result of COVID-19, as schools that usually fed them were closed due to the pandemic (O'Callaghan & Allott, 2021).

The next section reviews the literature about food waste policies in some of the countries in the world, which have been working towards reducing their food waste by setting targets and implementing them. These government policies aim to fight food waste through different ways like encouraging more efficient food production, passing laws to protect food donors from liability, and policy options for behaviour change. These policies provide an understanding of how some of the other countries in the world are dealing with the food waste issue and how New Zealand can be inspired from the manner in which this issue is being handled in other countries. This section also shows that governments are trying to seriously address this problem in ways that may or may not be effective and helps me in building an argument of why developing Food waste Literacy can be a good solution to address food waste.

2.2.6 Food waste policies

Food waste policies by the governments, along with efforts by businesses, organisations, and consumers, can reduce the amount of food that goes to waste and help in the conservation of natural resources, create economic opportunities, and provide food to the hungry (Schultz, 2017). While, globally the formulation of policies for handling food waste as a social and environmental priority has been relatively underdeveloped, some countries have drawn up specific legislation and policies to address the issue (Cooper, 2021). In almost all cases, the United Nations' (UN) Sustainable Development Goal (SDG) 12.3, has been the main force in inspiring countries to develop their national strategy to reduce food waste (Cooper, 2021). It was in September 2015, that the UN had set SDG 12.3 to globally reduce food waste by 50 per cent by 2030 (FAO, 2021b). Much before this UN initiative, there were some countries like Japan, South Korea, Denmark, France, and Norway which had outlined policies to tackle food waste in households and supply chains and had been on the path of leading the fight to end food waste. Japan was one of the first countries in the world to enact a 'Food Recycling Law' in 2001 to reduce and recycle food waste into feed and fertilizer (Umeda, 2019). Under that law, businesses that were producing large amounts of food waste, had to take measures to reduce and recycle food waste, and report their food waste statistics to the government periodically. In a 2016 study (Liu et al., 2016), it was observed that although Japan's 'Food Recycling Law' had been effective in reducing and recycling food waste, further efforts were needed to systematically reduce food waste, especially at the consumer level. In 2019, the Japanese parliament passed another law to reduce household food waste in accordance with the

UN's Sustainable Development Goal (SDG) 12.3, which calls on all nations to halve food waste and reduce food loss by 2030 (Ministry of Agriculture, 2021).

South Korea is another champion in reducing food waste by passing laws and taking various initiatives as early as in 2005, including banning dumping of food waste (Broom, 2019). In 2013, the government passed a compulsory food waste recycling bill called 'pay-as-you-throw', which requires separating food waste from the rest of the rubbish, paying for food waste by electronic machines and facing potential fines, in case of not recycling food waste. In a 2016 study (Ju, Bae, Kim, & Lee, 2016), it was found that the food waste recycling rate was over 90 per cent nationwide as a result of source-separated collection system of household food waste.

The Organization for Economic Co-operation and Development (OCED) had also undertaken a study in 2014 to collect data and explore food waste regulations in the OECD countries. This food waste study was initiated because reducing food waste was becoming a global phenomenon at that time and people were acknowledging its importance in relation to climate change, food security and water shortage (Bagherzadeh et al., 2014). Food waste data and policy information were gathered from public sources and then validated by experts. It was found that the health of consumers and food safety were the focus points of the governments' policies. Many policies were aimed at raising public awareness on the issue of food waste and to ultimately change behaviour towards food waste. This study cited the various policies which were in place in the OECD member countries, including New Zealand, at that time. It indicated that food waste was a part of the bigger problem of waste management under these policies, and no stand-alone policies were there to prevent food waste. The study referred to the names of legal frameworks or government policies in many countries that covered waste in general and were not specifically addressing food, like the *Waste Minimisation Act* in New Zealand (Bagherzadeh et al., 2014).

In France, according to Condamine (2020), 18 per cent of total food produced was wasted, of which 33 per cent of food waste happened at consumer level, and about 14 per cent happened at the retail level. France, in 2016, adopted a law on fighting food waste with the aim of avoiding food waste happening in the retail sector, through incentivising food donation and

forbidding the destruction of unsold food products. The law aimed at reducing food waste in France by 50 per cent by 2025 (Condamine, 2020). In 2017, the Norwegian government and their food industry signed an agreement to reduce food waste in Norway by 50 per cent by 2030 (Ministry of Climate and Environment, 2017). The aim was to reduce food waste across the entire food value chain from production to consumers which amounted at that time to 68 kg per person per year.

In the large country of the United States, in spite of a 2015 first ever announcement by the United States Department of Agriculture (USDA) and Environmental Protection Agency (EPA), to reduce domestic food loss and waste (FLW) by half by 2030, it was estimated that in 2018 food waste constituted about 24 per cent of the material going to landfills and formed 22 per cent of the amount combusted with energy recovery (EPA, 2021b). It was estimated that about 218 pounds of food waste per person was sent to landfills and combustion for energy recovery, and the aim is to reduce this by 50 per cent to about 109 pounds per person. A further progress was the signing of a ‘joint agency formal agreement’ under the ‘Winning on Reducing Food Waste Initiative’ in April 2019 by the USDA, the U.S. Food and Drug Administration (FDA) and the EPA (FDA, 2021). This Interagency Strategy had six priority areas to reduce Food Loss and Waste in the US and involves collaboration between government agencies and leaders in private, public, and non-profit organizations. In October 2019, the USDA, the FAD, and the EPA also signed an agreement with ReFED, Inc. (national non-profit organization) and Food Waste Reduction Alliance (FWRA) to reduce food waste in the United States.

The United Kingdom (UK) is another world leader in tackling food waste, owing to the efforts of many organizations (Department of Environment Food and Rural Affairs, 2020). The UK government had also funded a £1.15 million grant towards reducing food waste in the UK by 20 per cent by 2025 by changing people’s behaviour towards food waste. This funding was a part of a commitment of the UK government under the ‘Environment Bill’ passed in January 2020 to reduce food waste in the UK (Department of Environment Food and Rural Affairs, 2020). The latest data from ‘Waste and Resources Action Programme’ (WRAP) (a British not-for-profit organization) inform that the strategies developed under ‘Courtauld Commitment 2025’ are working towards reducing food waste in the UK (WRAP, 2020).

In another developed nation, Canada, the ‘National Zero Waste Council’ (NZWC) prepared and submitted the National Food Waste Reduction Strategy to the federal government in 2017 (NZWC, 2018). Henceforth, the first ever food policy for Canada was launched in 2020 which looked into various food-related issues including reducing food waste, to improve Canadian food system (Government of Canada, 2020a).

The Australian government acknowledges a significant amount of work is underway to target food waste which is making a difference locally, regionally and nationally (Australian Government, 2021a). Australia launched a National Food Waste Strategy in November 2017 which was aimed at halving Australia’s food waste by 2030 (Australian Government, 2017). The strategy identified four key areas where improvements could be made- policy support, business improvements, market development, and behaviour change. The initial step towards the strategy was to provide a funding of AU\$1.3 million over 24 months which was to be used to support: -

- an independent organisation that would develop an implementation plan. The organisation would also monitor and evaluate framework for the strategy, and coordinate priority areas of work.
- a voluntary commitment programme that will engage businesses and industries to commit to actions that reduce food waste.
- a national food waste baseline to monitor food waste reduction goals.

The Australian government committed another AU\$370,000 through its National Environment Science Programme to help establish a National Food Waste Baseline and identify the best opportunities for return on investment in food waste (Australian Government, 2017).

As this research is specific to Food Waste Literacy (FWL) in New Zealand, it was important to review food waste policies in New Zealand. According to a 2018 report by Parliament’s Environment Select Committee, a briefing was carried out to consider ways to prevent food waste in New Zealand (New Zealand Parliament, 2018). The briefing was based on an investigation which was aimed at understanding the challenges and offering solutions for reducing and preventing food waste. The Select Committee aimed to provide some recommendations for the future. As a first step in that direction, the Select Committee had

targeted around 30 organisations and individuals who were involved in the food sector or food waste and had sought their views on food waste issues, challenges, and possible solutions. The Select Committee appointed an independent specialist adviser to facilitate the research and analysis. The Select Committee put out a report in March 2020 (New Zealand Parliament, 2020) which recommended that the government adopt a national definition of, and measure of, food waste, in line with international approaches. It was suggested that a food waste definition should be broad and inclusive to include any food, and the inedible parts of food, taken out from the Food Supply Chain and consumption chain to be recovered or disposed of (New Zealand Parliament, 2020, p. 9). Food waste would be measured to establish a national baseline which would also project the hotspots for significant food waste in the country. It was also recommended that the government include reducing food waste in a targeted manner, as part of a national waste strategy and implementation plan. The reduction target could be aligned with the Sustainable Development Goal (SDG) Target 12.3. According to this report (New Zealand Parliament, 2020) the Ministry for the Environment informed that New Zealand is lagging behind several developed countries and the country does not have an up-to-date national strategy for food waste reduction.

Many recommendations were made to the Select Committee based on the appended report, the Mirosa Report (New Zealand Parliament, 2020, p. 18) which was drafted by the Select Committee's adviser, Miranda Mirosa. The recommendations included considering how food waste could be incorporated into lessons and extra-curricular activities at school. The Mirosa Report mentioned that there has been little academic interest in food waste and there is a dearth of information on quantities of food waste and localised solutions. The Mirosa Report suggested that there should be a focus on understanding the quantity of food waste, where it is being wasted and why. The Mirosa Report emphasised testing solutions to these issues, including new technologies and new approaches, and that government and industry should invest in food waste research (New Zealand Parliament, 2020).

In March 2020, a group of 12 food waste champions from the New Zealand food supply chain like Countdown (supermarket chain), Foodstuffs (New Zealand's largest grocery retailer), KiwiHarvest (non-profit food rescue organisation), WasteMINZ (the largest representative of the waste and resource recovery in New Zealand) and Sustainable Business Networks

(sustainable business organisation of New Zealand) committed to halving food waste by 2030 and achieving SDG Target 12.3 and called themselves *NZ Food Waste Champions 12.3*. (NZ Food Waste Champions, 2020). These individuals aim to accelerate progress and mobilise action towards reducing food waste across New Zealand's food supply chain. They will also be leading momentum towards government, businesses, research institutions, and individuals collectively achieving the goal of halving food waste by 2030 (Love Food Hate Waste, 2021). The *Champions* believe that food businesses would benefit from the discussion around how to reach SDG Target 12.3 and incorporating it in their sustainability plans. The *NZ Food Waste Champions 12.3* hope that the New Zealand Government eventually commits to Target 12.3 just like Australia and the United States. The *NZ Food Waste Champions 12.3* along with the Waste Management Institute New Zealand (WasteMINZ) organised the country's first food waste summit on 22nd March 2021 in Māngere, New Zealand. The aim of the summit was identifying the barriers to, and the opportunities for reducing food waste (Pritchett, 2021). There were speakers from different parts of the Food Supply Chain (FSC), from paddock, packhouse, presentation (hospitality and retail) and plate (household) sections. Many opportunities were made visible under the different parts of the FSC. Under the consumer section of reducing food waste, it was highlighted that even though over 120 tonnes of food are thrown out by New Zealand households each year, there is a significant barrier to reducing food waste as there is a lack of consumer understanding and difficulty in changing behaviour (Pritchett, 2021). The suggestions for reducing food waste included individuals improving their own food waste behaviour, ongoing support for education through organisations such as Love Food Hate Waste (LFHW), and daily acts to reduce food waste by each of New Zealand's five million citizens to bring about change.

The *NZ Food Waste Champions 12.3* launched the *Champions 12.3 Food Waste Reduction Roadmap* on Stop Food Waste Day on 28th April 2021 (Pritchett, 2021). The 60-page *Roadmap* identifies solutions for each section of the food waste chain in collaboration with the government. The *Roadmap* suggests that the government should urgently set a food waste reduction target in line with the SDG 12.3 or explore a ban of food waste to landfill (NZ Food Waste Champions 12.3, 2021). According to the *Roadmap*, the government may support a voluntary commitment programme with a target, measure, act approach to reduce food waste. There should be policies in place to progress existing commitment to agreed definitions and data collection through a food loss and waste baseline. For reducing food waste at household

level, the government could support national awareness campaigns on prevention, work towards better infrastructure for diversion from landfills, and implement effective household organic collections across the country.

In terms of legislation, the New Zealand Food Act's 2014 clause 352 is perhaps the only government measure towards reducing food waste in the country at the moment. Clause 352 is colloquially known as the 'Good Samaritan Clause' (Ministry for Primary Industries, 2021a) and specifically permits businesses to donate unsold food (New Zealand Legislation, 2021) and provides immunity to the food donors. Food businesses that donate food are protected from civil or criminal liability under the Food Act 2014, provided the food was suitable and safe when donated, and came with any information needed to keep it safe and suitable (Ministry for Primary Industries, 2021a). But this position of the New Zealand government may change soon. In April 2022, the government had opened a public consultation for a plan to reduce food waste being sent to landfill, by proposing that all businesses should separate food waste from general rubbish (Ministry for the Environment, 2022). The proposal also aims at providing kerbside food scraps collection for the households throughout the country. The businesses will have the flexibility of using their food scraps for compost, digestate or stock feed

2.2.7 Summary of food waste

The study on food waste by the Food and Agricultural Organisation (FAO) in 2011, the first of its kind, had suggested that food waste in industrialized nations could be reduced by raising awareness among food industries, retailers, and consumers (FAO, 2011). The study had also revealed that there has been major data and research gaps in the knowledge of food waste globally and there was an imminent need for further research in the area. Following this seminal study by the FAO there has been a spurt of research in food waste encompassing its quantity, impact, reasons, significance, and policy changes. Many non-profit organisations in various countries, and some countries' governments have also been striving to reduce food waste. Some countries and communities have been proactive in tackling food waste issues by implementing a multi-pronged approach including policy changes, creating campaigns for consumers education, and attempting to bring about positive behavioural changes in the communities. However, it has been felt that a meaningful reduction in food waste is unlikely to be achieved through a policy or intervention (Government Office for Science, 2017). Over the years it

became apparent that an important component of driving behavioural change is educating the community on the economic, social and environmental costs of producing food and also the benefits of reducing food waste (Australian Government, 2017). Since consumers are responsible for so much of the food that is ultimately wasted, consumer education and behaviour change initiatives have been described as crucial in the context of New Zealand food waste issue (New Zealand Parliament, 2020). Suggestions have been made to the policy makers in New Zealand that ‘doggy bags’ may be provided to the customers so that they can carry home unfinished meals (New Zealand Parliament, 2020). There are many countries which are now convinced that raising awareness and knowledge about food waste as a long-term solution may be possible through creating literacy about food waste (Aschemann-Witzel, Ho, & Soma, 2020). Therefore, the literature review now focuses on literacy and how it can be connected to creating awareness and change of behaviour towards food waste.

2.3 Conceptualising literacy

2.3.1 Definition of literacy

The concept of ‘literacy’ is being used in broad terms in this study. According to the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the word literate can mean ‘well-educated or learned’, but the debate around the meaning and definition of the word has evolved from a simple process of having basic cognitive skills, to using these skills for socio-economic development, to developing the capacity for critical reflection leading to personal and social change (UNESCO, 2006). UNESCO described literacy under four approaches: literacy as an autonomous set of skills; literacy as applied, practiced, and situated; literacy as a learning process; and literacy as a text (UNESCO, 2006). In fact, literacy is no longer considered just an individual transformation, but as a societal and contextual transformation. Literacy is thus a continuously developing set of practices which develop throughout the lifetime of a person related to real tasks and purposes (Frankel, Becker, Rowe, & Pearson, 2016). Moreover, literacy is seen to have a ‘multiplier effect’ which enables people to have a fuller participation in society resulting in improved livelihoods (UNESCO, 2019). Literacy is also seen as a means for sustainable development as “it enables greater participation in the labour market; improved child and family health and nutrition; reduces poverty and expands life opportunities” (UNESCO, 2019). UNESCO also explained literacy as a means of “identification, understanding, interpretation, creation, and communication in an increasingly digital, text-mediated, information-rich and fast-changing world” (UNESCO, 2019). Frankel

et al. (2016) explained literacy as a constructive and integrative process which is situated in social practices.

The idea of multiple literacies for changing times was proposed in 1996 by the New London Group of educational researchers (The New London Group, 1996). It was suggested keeping in mind the changing global educational environment and “the multiplicity of communication channels and media, and the increasing saliency of cultural and linguistic diversity” (The New London Group, 1996, p. 63). It aimed at making teaching and learning more inclusive of linguistic, cultural, communicative and technological diversity (Milligan, Hunter, & Harcourt, 2016). As a result of this broader definition of literacy, newer forms of literacy came into being, like digital literacy (Gilster, 1997), media literacy, visual literacy, data literacy, news literacy etc. With such a diversity in the meaning of literacy, I now review the literature which explains the form of literacy which concerns my research.

2.3.2 Food literacy

Studies have been exploring the broader construct of another form of literacy, known as food literacy, in recent years and there have been various viewpoints on what food literacy is. Australian researchers Vidgen and Gallegos provided a functional definition of food literacy. According to them, food literacy is “the relative ability to basically understand the nature of food and how it is important to you, and how able you are to gain information about food, process it, analyse it and act upon it” (Vidgen & Gallegos, 2011, p. 33). The researchers also suggested that inadequate food literacy leads to an unwillingness to change positively towards food perceptions, confusion in selecting and consuming food, and food waste (Vidgen & Gallegos, 2011). Vidgen and her associate further expanded the meaning of food literacy and suggested that: -

Food literacy is the scaffolding that empowers individuals, households, communities, or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare and eat food to meet needs and determine intake. (Vidgen & Gallegos, 2014, p. 54)

The components of food literacy were also analysed which were categorized under the domains of planning and management of food, selection of food, preparation, and eating of food (Vidgen, 2016). It was suggested that all the components may not always be present in everyone, but the lack of even one component affects the entire gamut of food literacy for that individual. Moreover, when any component is missing, the whole association with food is different and it is difficult to bring about any changes. In fact, food literacy was seen as a kind of intellectual capital, which demonstrates significant impacts on individual and collective behavioural intentions (Palumbo, 2015). Although this research had filled a much-desired gap in defining food literacy, it did not include food not getting wasted, under any of its four domains. This research mainly focussed on providing a definition of food literacy and its components, and how to meet everyday nutrition recommendations.

Alternatively, Bellotti (2010) enhanced the narrow functional definition of food literacy and offered food literacy as a multi-faceted term which encompasses three parts. The first part refers to food, nutrition, and health which deals with the issue of one's food choices affecting personal health. The second part refers to agriculture, environment, and ecology which concerns the impact of one's food choices on the environment. The third section on social development and equity, focusses on the impact of one's food choices on local communities (Bellotti, 2010). Bellotti emphasised that food literacy provides a framework for rediscovering our relationship with food, knowing how our food choices impact on our health and environment, and the businesses and communities involved in the provision of food (Bellotti, 2010, p. 34). This viewpoint of food literacy thus includes the skills and abilities of individuals to properly use food to acquire better health, contribute in the development of a sustainable agriculture, and collaborate in the accomplishment of social equity outcomes (Palumbo, 2015). Aligning with this viewpoint of food literacy by Bellotti, education in the subject of food literacy was seen as "a useful way of examining the interplay between social, political, economic, and environmental aspects of many food issues" (Pendergast & Dewhurst, 2012, p. 245).

Food literacy has also been explained along the same lines, in a Report by the Conference Board of Canada as addressing household attitudes, skills and knowledge about food (Howard & Brichta, 2013). According to the Conference Board of Canada, food literacy is a broad term

which encompasses “household perception, assessment, and management of the risks associated with their food choices” (Howard & Brichta, 2013, p. 16). The Report suggested that people’s food literacy levels influence their food choices and decisions, which in turn affect their health and the environment too. It further argued that food literacy also included an individual’s understanding of how food had been produced, processed, transported, purchased, and wasted, and how to understand food marketing and advertising. The Report presented: food literacy as a sub-set of health literacy as it is related to the health outcomes of the people; food literacy and dietary outcomes; and food literacy and environmental outcomes. The report also suggested strategies for improving food literacy among households in Canada (Howard & Brichta, 2013). The Report reported that information and education for improving food literacy are crucial but must be presented using strategies that engender lasting behavioural changes.

Food literacy was also described (Sumner, 2013) as the understanding of the environmental, social, economic, cultural, and political outcomes of individuals’ decisions about food, in a perspective of enhanced sustainability of individual and social well-being. The researcher explained food literacy as: -

Food literacy is the ability to “read the world” in terms of food, thereby recreating it and remaking ourselves. It involves a full-cycle understanding of food—where it is grown, how it is produced, who benefits and who loses when it is purchased, who can access it (and who can’t), and where it goes when we are finished with it. It includes an appreciation of the cultural significance of food, the capacity to prepare healthy meals and make healthy decisions, and the recognition of the environmental, social, economic, cultural, and political implications of those decisions. (Sumner, 2013, p. 8)

A little later, Truman et al.’s (2017) concept of food literacy included a set of knowledge, skills and attitudes concentrated into six domains. They are: - skills and behaviours which involve physical actions involving food, food choices, culture involving societal aspects of food, knowledge involving ability to understand information about food, emotions involving food, and food systems involving the ability to understand the complexity of food systems.

All these definitions of food literacy offered by researchers have included aspects of personal health, food and nutrition, community food security, food skills and better decisions involving

food (Cullen et al., 2015; Vaitkeviciute et al., 2015). These definitions of food literacy show that the use of the term is wide ranging, spanning from food choices to food production to food marketing. But mainly, two viewpoints can be seen in the current definitions of food literacy. The narrower viewpoint is for individuals making better and healthier food choices for themselves, whereas, the broader viewpoint encompasses the collective well-being, in the context of economic, political, environmental and social implications (Palumbo, 2016). Research in the field of food literacy is being undertaken, but it is mainly focussed on the narrower perspective of individual good. The research approach needs to change to keep the broader perspective of the collective good in focus. This has the potential to lead to a more sustainable future in terms of food. The next section reviews the literature which explores the connections between food literacy and how it may impact the sustainability of limited natural resources.

2.3.3 Food literacy and sustainability

Food literacy can foster learning that supports the local context and community and make the communities more sustainable. Food literacy has also been associated with the concept of “well-being sustainability” (Palumbo, 2015) rather than a collective sustainability for the world.

It was suggested by Bonnett (1999) that environmental education should aim at developing sustainability as a mindset and as an attitude reflected in the day-to-day behaviour and actions of individuals. However, it had not been a priority for households to think how the food issue is affecting the environment (Agriculture and Agri-Food Canada, 2010), yet household decisions regarding discarding food, were pushing the ideas of the local, organic food movement, along with environmental sustainability efforts. It had been suggested that any change from the present status of unsustainable production, consumption, and disposable ways needed individual behaviour change (Redman & Redman, 2014). Redman and Redman suggested that educators could change the behaviour of the next generation of individuals towards sustainable waste patterns, by incorporating the appropriate knowledge into the senior school classroom. However, their study was focussed on the knowledge domain and the individual behaviour of educators, and not students.

Education has often been referred to as the pivot point for enabling future generations to cope with sustainability challenges, by imparting the appropriate knowledge, skills, and behaviours (Cortese, 2003). Within schools, teachers have the capacity to reach a younger population that has yet to become resistant and fixed in their habits and behaviours to change (Kelder, Perry, Klepp, & Lytle, 1994). In a study undertaken by the University of the West of England to study staff perceptions of implementing the ‘Food for Life Partnership Programme’ (FFLP), it was found that Education for Sustainable Development (ESD) is a complex issue (Weitkamp, Jones, Salmon, Kimberlee, & Orme, 2013). The study emphasised that ESD should be a part of education of upper primary or secondary school children as this age group would be better suited to acknowledge its importance. However, the FFLP study mainly focussed on the perceptions of staff, and the experiences of the students were covered in a very limited manner. The study did not take into account if any of the FFLP’s practices and values were internalised by the students and brought into their day-to-day relationship with the environment.

Even when food literacy is a component of school curriculum, the time allowed for the compulsory teaching of food-related studies may not be enough (Ronto, Ball, Pendegast, & Harris, 2017). In this Australian study on food waste, the allotted time of one year for high school students, was deemed to be insufficient to introduce broader concepts of food literacy like environmental sustainability, and to develop sustainable food-related life skills (Ronto et al., 2017). The study suggested that the status of food literacy education should be increased in the Australian schools, and it should not remain just a part of the health and physical education curricula.

Over the last few years, food literacy studies have depicted food literacy as a determinant of environmental sustainability, yet much food literacy discourse focusses on the sustainability of well-being. There is a greater need of encouraging people to unlearn unsustainable foodways and to learn a more sustainable relationship with food on every level, and remake themselves as active participants, or citizens, in their food systems (Sumner, 2015).

2.3.3.1 Food citizenship and sustainability

Food citizenship has also been emerging in the field of food literacy as an extension of the concept of general citizenship to the sphere of food (Gómez-Benito & Lozano, 2014). The role of the citizenry in achieving a sustainable model of food production and consumption was contemplated, and it was identified that it is only through active food citizens that sustainable food systems could be constructed (Gómez-Benito & Lozano, 2014). The concept was explained as the practice of engaging in food-related behaviours that support, rather than threaten, the development of a democratic, socially and economically just, and environmentally sustainable food system (Wilkins, 2005, p. 269). The word ‘citizen’ conveys the notion of being a member of a state or nation and having a citizenship involving rights as well as duties or responsibilities. Food citizenship can therefore imply that in relation to our food choices, we have certain rights and responsibilities too (Wilkins, 2005). As food citizens, people have certain rights but also certain responsibilities in regard to food and the food system (Campisi, 2019). Food citizenship enables consumers to experience community through a symbiotic relationship with local agricultural production instead of its end users (Shifren, Lawry, & Bhappu, 2017). Being food citizens, people are not passive consumers, but are informed about food and environmental issues (Hassanein, 2008). Food citizens may have a direct engagement with decision-making processes and have a relationship with other stakeholders in industrial food systems, and can work and gain some control over their food system (Campisi, 2019). The concept of food citizenship holds that food choices cannot be seen only under citizens’ rights, instead it is also an issue of duties, responsibilities, and obligations towards all people, consumers and producers, and the environment (Gómez-Benito & Lozano, 2014, p. 150). According to Wilkins (2005), being a food citizen, it is necessary to think about the implications of how we eat.

There can be barriers and enablers to food citizenship, which were explored by O’Kane (2016). He observed that the supermarket shoppers’ disconnection from those who grow food and where it was grown disempowered the consumers from making sustainable food choices. Moreover, it was suggested that to enable people to have a greater commitment to food citizenship, adjustments to the macro-level food environment was required (O’Kane, 2016). Food citizenship may also express a belief in a food model that includes sustainability in economic, social and environmental spheres (Gómez-Benito & Lozano, 2014). As good food citizens, people have a responsibility to purchase locally produced foods as ‘food miles’,

meaning the distance food travels from farm to plate, for local foods are less than foods produced outside a particular geographical range (McGregor, 2016). Local food is thus thought to be more ecologically sustainable based on lesser food miles. Food citizens are thence individuals who have an active interest in exercising their food choices, which requires an effort to know that it is healthy food, and conditions and the processes of the production and distribution of food (Gómez-Benito & Lozano, 2014). Food citizens thus cultivate a set of values, attitudes and behaviours in their food choices and habits which adds in some way to collective actions towards sustainable food.

Cultivation of this ‘sustainability mindset’ had also been advocated by Wals (2011), where his focus of sustainability education was on capacity building and critical thinking. According to Wals (2011), sustainability education should be emancipatory, resulting in empowered and competent learners who can critique, construct and act with self-determination. An emancipatory approach to sustainability education assumes that learners actively and critically participate in problem solving and decision making (Wals & Jickling, 2002). The creation of a more sustainable world, in turn, requires social learning which emphasises the cultivation of pluralism and heterogeneity (Wals, 2011, p. 181). In short, people learn more from each other when they are different from each other and with social cohesion amongst them (Wals, 2011). Social learning has been defined as “the collective action and reflection that takes place amongst both individuals and groups when they work to improve the management of the interrelationships between social and ecological systems” (Dyball & Keen, 2005, p. 4). Social learning is thus learning by mirroring one’s own ideas, values and perspectives with those of others (Wals, 2011, p. 181) which leads to alternative values and co-created solutions by more reflexive learners, for a sustainable world. Social learning contributes towards becoming food citizens who are aware of ‘sustainable food’ and cultivate values, attitudes, and behaviours in their food choices and habits (Gómez-Benito & Lozano, 2014).

An important task of education, then, is to help learners to appreciate and use different mindsets (Wals, 2011, p. 182). The education system has proven to be an effective medium through which various issues of important social change are exposed to the youngest members of our society and this influence can lead to change in our food attitudes, values, and behaviour. A Canadian (Rojas et al., 2011) study suggests that schools are a site for food system

transformation and by increasing food and sustainability literacy together in educational systems, the societies can begin to overcome passivity and consumerism towards food.

A long term positive impact of food literacy education, in strengthening the relationship between citizens and food systems (Nanayakkara, Margerison, & Worsley, 2018) was indicated by an Australian study at a senior secondary school. The participating students emphasised the role of food literacy in nurturing critical thinking skills about the social value of food, food system issues, and relationships between environmental stability and the food system.

Based on the research evidence, it appears that our understanding of food waste, food literacy, food citizenship and sustainability has not yet been clearly elucidated, and, therefore, it can be important to explore young people's understanding of the relationship between them. Food waste makes an important integral component in food literacy, food citizenship, and sustainability and should find a unique place as Food Waste Literacy (FWL). In the next section, I present the connections between the various concepts and how they all contribute towards developing Food Waste Literacy

2.3.4 Food Waste Literacy and sustainability

2.3.4.1 Food waste and sustainability

According to a 2011 decisive report by the Food and Agricultural Organisation of the United Nations (FAO), each year, worldwide, wasted food used up a volume of water equivalent to the annual flow of Russia's Volga River. The report stated that, beyond its environmental impacts, the direct economic consequences to producers of food waste (excluding fish and seafood) was, globally, about \$750 billion annually at the time. Food waste was also responsible for increasing the food prices and international food shortages further leading to food insecurity. The FAO reported that if only one-fourth of the food lost or wasted globally was consumed, it would be sufficient to feed 870 million people, 12 per cent of the world's current population at that time (FAO, 2011). The earth's resources are limited and not infinitely expandable, while the human population is growing. According to a newspaper article in *The Economist*, by 2030, the world population of 7 billion "will need twice as many resources as the planet can supply" (J.A., 2012). However, the attitudes towards food waste have been consuming natural resources and compounding the problem. On the first International Day of

Awareness of Food Loss and Waste on 29th September 2020, the United Nations Environment Programme (UNEP) reported 690 million hungry people in the world which was made worse by an additional 132 million hungry people because of the impact of COVID-19 pandemic (UNEP, 2020).

The value embedded in food waste is increasingly being recognised, with the United Nations aiming at 50% reduction in consumer food waste by 2030 (Slorach, Jeswani, Cuéllar-Franca, & Azapagic, 2020). According to the latest World Bank report (World Bank, 2022), domestic food price inflation remains high around the world, partially caused by the war in Ukraine. High food prices are driving millions across the world into poverty, magnifying hunger and malnutrition, and there will be about 222 million people, worldwide, who will be experiencing acute food shortage and requiring urgent assistance (World Bank, 2022). In the context of New Zealand, about 15-20% of the population is impacted by food insecurity and high food prices have been a key contributing factor towards that (Commerce Commission New Zealand, 2021). The higher food prices have further contributed to higher inflation for households in New Zealand (Stats NZ, 2022). In this environment of uncertainty and higher food prices, reducing food waste becomes even more critical as it reduces costs and controls supply chain risks.

Historically, as a result of the crucial report by the FAO, the United Nations (UN) and agencies like the Environmental Protection Agency (EPA), urged everyone to work towards reducing food loss and food waste or risk even a greater drop in natural resources. This appeal of the UN and the EPA was for cultivating sustainability. Sustainability was summed up by the EPA as creating and maintaining the conditions under which humans and nature can co-exist in a harmonious and productive manner, for the present and the future generations (EPA, 2016). The UN defined sustainability development as the development that meets the need of the present without affecting the future generation's needs (UN, 2015). The UN declared that for sustainable development to be achieved, it is necessary to balance three core elements: economic growth, social inclusion, and environmental protection. These three elements are interrelated and are important for the well-being of individuals and societies.

Realising that unless sustainability, sustainability development and caring for the environment is kept in focus in the use of food, there will eventually be a difficult situation for both humankind and the environment, the UN framed 17 Sustainable Development Goals (SDG) in 2015 to tackle various global issues using sustainability as a tool. SDG 12.3, as a part of SDG 12 which talks of sustainable consumption and production, stated that as food loss and food waste reduction would likely be more efficient to increase food availability, the aim should be halving per capita global food waste by 2030 (UN, 2015). In a study by Beretta & Hellweg (2019) it was demonstrated that the SDG 12.3 is realistic and food waste prevention in the food service sector could affect its aggregated environmental impacts in a beneficial way.

One of the ways to spread awareness about sustainability and development of Food Waste Literacy has been through education. UNESCO's *Global Education Monitoring Report Summary* (2016) observed that education has a responsibility to foster the right type of skills, attitudes and behaviour that will lead to sustainable growth. The report stated that education has been seen as a very important factor in addressing environmental and sustainability issues and ensuring human well-being (UNESCO, 2016). Learning to reduce waste of food at an early/formative age can lead to better use of resources and conservation. Hence, it is important to evaluate the growth of Food Waste Literacy which is a form of sustainability education. The next section reviews the literature on sustainability education and food waste.

2.3.4.2 Environmental and sustainability education

Ideas for how to educate for a more sustainable future, such as through reducing food waste, began with an initial focus on Environmental Education (EE). The origin of EE can be traced, initially, to creating awareness about nature, and then for the conservation of the environment. The inclusion of conservation in education started in the middle of the previous century and was aimed at understanding the importance of natural resources (Stevenson, 2007). But it was in 1972 that education on environmental issues was considered an important measure to protect the environment as claimed by the *Stockholm Declaration* at the *United Nations Conference on the Human Environment* (Stevenson, 2007). Following this, the *Tbilisi Declaration* by United Nations Education, Scientific, and Cultural Organization (UNESCO) along with the U.N. Environment Programme (UNEP) in 1977, unanimously granted importance to the role

of environmental education in the preservation and improvement of the world's environment (Stevenson, 2007).

Until the 1970s and 1980s, environmental education was viewed as apolitical, naturalist, and plain scientific work. But in the next decade, the focus shifted towards the problems of contemporary society (Tilbury, 1995). In 1983, the UN convened the World Commission on Environment and Development (WCED) which then published a report in 1987 named *Our Common Future*. The WCED gave prominence to the concept of sustainability and defined it as the development that meets the need of the present generation without compromising the needs of the future generations (Thomsen, 2013). Therefore, sustainability should also include Food Waste Literacy so that enough food continues to remain available to maintain human population in the future.

Much later, in 1991, a document called *Caring for the Earth: A strategy for sustainable living* was launched by the United Nations Environment Programme and World-Wide Fund for Nature (UNEP-WWF for Nature). This document also laid emphasis on the role of education in bringing about changes towards sustainable lifestyles (UNEP-WWF, 1991). It called for environmental education that would enable citizens to understand, appreciate and implement sustainable practices. The document helped in establishing education for sustainability as the main aim of environmental education in the 1990s (UNEP-WWF, 1991). In 1992, at a United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, the Rio declaration, also known as *Agenda 21*, was adopted. *Agenda 21* was a comprehensive global plan of action to promote sustainable development (UN, 2015). As a result of these initiatives in the 1990s, environmental education started focussing on environmental sustainability for the long term, rather than just looking at immediate environmental issues (Tilbury, 1995).

The importance of education for sustainable development could be gauged from the fact that the United Nations (UN) declared 2005-2014 as the 'Decade of Education for Sustainable Development'. The overall goal of this decision was to integrate the values of sustainable development into all the aspects of learning to motivate behaviour change in people, to create

a more sustainable society for all (UN, 2005). The three pillars of ‘Education for Sustainable Development (ESD)’ were: -

1. Society: an awareness of the role and functions of various social institutions in the change and development of the environment.
2. Environment: an understanding about the precarious physical environment and the effect of human activities on it.
3. Economy: a sensitivity towards the economic growth and its impact on the environment, accompanied by a commitment to assess personal and collective levels of consumption as a concern for the environment.

This declaration connected these three pillars through culture as an underlying dimension, which had been a characteristic of sustainable development. It emphasised sustainable development as a relationship between people, and between people and their environment. In other words, sustainable development was highlighted as a socio-cultural and economic concern. Education was considered a tool to foster the values, behaviour and lifestyle changes needed for a sustainable future. ESD was to be integrated across the whole school curriculum and not just being a separate subject. It aimed at addressing both local and global issues. The declaration focussed equally on both the developing and the developed nations. It asked for an increased attention to ESD wherever there was over-consumption and wasteful lifestyle patterns (UN, 2005), and therefore has direct relevance to the issue of food waste.

During the same time, building up students’ action competence with reference to environmental concerns was seen as one of the overall objectives of environmental education (Jensen & Schnack, 1997). Jensen and Schnack (1997) advocated the development of students’ action competence which would focus on students’ abilities to visualise their future, and reflect and respond to present and future environmental issues. Jensen and Schnack emphasised that students decide to do something, take action, alone or with others, by changing behaviour or attempting to address the environmental concerns (Jensen & Schnack, 1997, p. 168). An action should be directed at solving a problem and it should be decided upon by those preparing to carry out the action (Jensen, 2002, p. 326). These actions in the context of environmental education can be direct or indirect, or individual or collective. Direct actions like plogging (the act of jogging while picking up litter) are aimed at directly solving environmental, while

indirect actions like environmental awareness campaigns help in influencing others to do something to contribute to solve environmental concerns (Jensen & Schnack, 1997). Four aspects of action competence were pointed out by Jansen and Schnack (1997). They were: -

- i. knowledge and insight about what the environmental problems are, how they arose and what possibilities exist for solving them.
- ii. commitment and courage to solve the problem by promoting students' motivation.
- iii. visions about good future lives.
- iv. action experiences which stress the benefits of taking concrete action during teaching at school.

Jensen and Schnack further argued that the concept of action competence includes the capacity to be responsible for one's action and to be able to act, now and in the future. In the context of environmental education in schools, performing actions does help to develop action competence (Jensen & Schnack, 1997, p. 175).

Running through the history of Environmental Education and Education for Sustainable Development, has been the tension between the instrumental and emancipatory approaches of education (Wals & Benavot, 2017). Instrumental approaches develops knowledge, awareness, and skills that may develop specific environmental behaviours; while emancipatory approaches focusses on education which develops capacities and literacies based on sustainable values and principles (Wals & Benavot, 2017). However, Jickling maintained that education for any cause is not true education and educators should strive to prepare minds to create new ideas and not follow a doctrine. Jickling (Jickling & Wals, 2012) has been doubtful about the idea of sustainable development being adequate to enable thoughtful and effective responses to local and global issues, and even though Education for Sustainable Development may have good educational ideas, it is a kind of feel good education because it is ultimately constrained by the ideas of sustainable development (Jickling & Wals, 2012, p. 55).

Considering Food Waste Literacy as a possible outcome of sustainability and Environmental Education it is important to situate it alongside the broader notion of Environmental Literacy (EL). Environmental Education is grounded in different inter-related aspects of our relationship with the environment: as nature, as problems, as a territory to belong to, to care and share, and

as a community socioecological project (Berryman & Sauvé, 2016). Environmental Education can be considered a global framework enclosing the diverse possibility of relating to the environment. Developing Food Waste Literacy, as an extension of Environmental Literacy, may help to construct the meaning of students' relationship with food.

2.3.4.3 Food Waste Literacy as a form of Environmental Literacy

In terms of food waste, individuals need to develop a type of Environmental Literacy (EL) to manage food and avoid wasteful food practices. I propose the term as Food Waste Literacy; however, we need an understanding of the broader concept of EL to understand Food Waste Literacy better. The term Environmental Literacy may have been used first by Charles Roth in 1969 in an article in *Massachusetts Audubon*. He posed the question “How shall we know the environmentally literate citizen?” in that article (Roth, 1992, p. 7). Roth defined EL as the “capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems” (Roth, 1992, p. 7). He argued that developing EL was one of the aims of EE and explained EL as a continuum of competencies from nominal to functional to operational levels, corresponding to a range from zero level to a very high level of EL.

Much later in 2011, the North American Association for Environmental Education (NAAEE) provided a definition of EL in the document *Developing a Framework for Assessing EL*. The definition discussed that EL is “knowledge of environmental concepts and issues; the attitudinal dispositions, motivation, cognitive abilities, and skills, and the confidence and appropriate behaviours to apply such knowledge in order to make effective decisions in a range of environmental contexts” (Hollweg et al., 2011, p. 3.1). The various components of the definition of EL were further elaborated as follows: EL requires some scientific knowledge of the Earth’s system, physical and ecological systems, and social, political, economic, and cultural influences on the environmental issues. The inclination to act is important for EL, which is mentioned as a disposition in the definition of EL. These attitudinal dispositions may be called under different names like environmental attitudes, environmental sensitivity, or intention to act but all these dispositions make individuals incline towards actively engaging in decision making and problem solving. Appropriate behavioural strategies for life-long environmentally responsible behaviour develop in students, through active participation in

real-world experiences. EL leads individuals to apply knowledge and understanding of environmental issues and take effective actions based on informed and evidence-based decisions (Hollweg et al., 2011).

Accordingly, EL consists of four interrelated components: knowledge, dispositions, competencies, and environmentally responsible behaviour which form an interactive domain structure. The NAAEE further elaborated that the first part of the domain of EL is made up of five types of knowledge consisting of physical and ecological systems, social, cultural, and political systems, environmental issues, multiple solutions to the environmental issues, and citizen participation and action strategies. Dispositions make the second component of the EL domain. Dispositions are made up of one's sensitivity towards the environmental issues, attitudes and concern towards the environment, assumptions of personal responsibility, and motivation, and intention to act. Students' dispositions towards the environment are important as they influence their willingness to act on decisions to improve the well-being of others, and their choice of value perspectives. Moreover, dispositions also motivate the students' participation in environmental issues (Hollweg et al., 2011). Competencies is the next component of the domain of EL. The NAAEE has explained competencies as a set of skills and abilities that are used in the real world and assessment settings for a particular aim. Since competencies are influenced by one's knowledge and dispositions, both the development and expression of competencies lead to the development of EL. Hence, knowledge, dispositions, and competencies are expressed through behaviours.

Context is an integral part of the domain of EL, and environmental action is dependent on the personal, social, and physical context for individuals. Finally, the last part of the domain of EL is 'environmentally responsible behaviour.' Environmentally responsible behaviour is the "expression of knowledge, dispositions, and competencies within a context" (Hollweg et al., 2011, pp. 3-12). I have depicted this domain of environmental literacy based on my understanding in the figure below (see Figure 2.1).

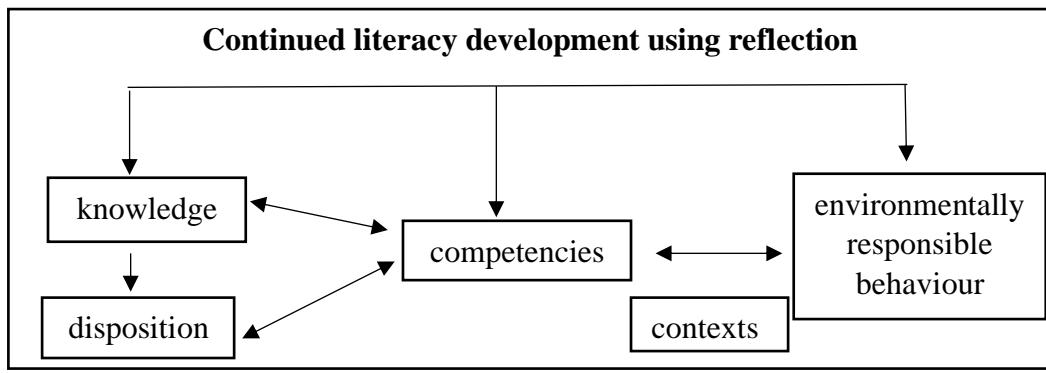


Figure 2. 1 The domain of Environmental Literacy

Hence, behaviour is the final expression of environmental literacy, and it occurs on a continuum. It is an ongoing development process which is facilitated by reflection, further learning and additional experiences (Hollweg et al., 2011). In a study in the UK, Barr (2007) suggested that the behaviour of the research participants, towards waste was predicted by underlying environmental knowledge and values. The NAAEE had also emphasised that an environmentally literate person, both individually and together with others, makes informed decisions about the environment, and uses appropriate skills and behavioural strategies. In the context of my study, developing students' Environmental Literacy will also be affected by the class teacher's Environmental Literacy (Kidman & Casinader, 2019), which may be developed alongside the students' inquiry-learning. Students' environmental literacy may also be promoted using interventions (Grodzinska-Jurczak, Bartosiewicz, Twardowska, & Ballantyne, 2003; Pan & Hsu, 2020) which may be a programme designed to produce behaviour changes among individuals or an entire population (Michie, van Stralen, & West, 2011). Table 2.2 presents some of the definitions which I have referred to in my study and which are instrumental in developing my definition of Food Waste Literacy.

Table 2.2 Different literacies used in my study

Literacy	Source	Definition
Environmental Literacy	NAAEE, Hollweg et al., 2011	Environmental Literacy is knowledge of environmental concepts and issues, the attitudinal dispositions, motivation, cognitive abilities, and skills, and the appropriate behaviour to apply such knowledge in order to make effective decisions in a range of environmental contexts.

Food Literacy Vigden Gallegos (2014)	& Food literacy is the scaffolding that empowers individuals, households, communities, or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare and eat food to meet needs and determine intake.
Howard Brichta (2013)	& Food Literacy is a broad term which encompasses “household perception, assessment, and management of the risks associated with their food choices.”
Vaitkeviciute et al. (2015)	Food Literacy is not just nutrition knowledge; it includes skills and behaviours, from knowing where food comes from to the ability to select and prepare these foods and behave in ways that meet nutrition guidelines.
Food Waste The Literacy researcher (2020)	Literacy for the judicious use of food by acquiring the ability to use the food produced efficiently, with an understanding of concepts from the production to consumption of food.

2.3.4.4 Food waste behavioural interventions

Information based interventions, where information is provided to change the behaviour of the target group to reduce food waste have been commonly used in reducing food waste (Simões, Carvalho, & Gaspar de Matos, 2022). A student-focused education campaign resulted in about 33% food waste reduction in main dishes (Reynolds et al., 2019). According to Reynolds et al. (2020), the interventions may improve people’s behaviour towards food waste; however, people may likely fall back into their post intervention behaviour as soon as the intervention is stopped. These findings are in line with a two-week education intervention programme for a small group of middle and high school students in the Netherlands (Gertrude, Sandra van der, & Geertje van, 2020). The intervention was aimed at fostering behaviour change towards waste and food. The study indicated that the intervention increased the students’ sustainability

knowledge in terms of food and waste. After one year, the students showed considerable changes in their waste decisions, but sustainable food behaviours were found to be more resistant to long-term change. However, an Australian study demonstrated that school-based food waste reduction intervention may influence students' behaviour and reduce food waste (Boulet, Grant, Hoek, & Raven, 2022a). The study suggested that school-based food waste interventions may mobilise students as agents of change in tackling the global food waste challenge.

There have been studies related to food waste behavioural interventions in New Zealand. A food waste behavioural study in New Zealand indicated that an effective community-based social marketing campaign can encourage consumers to change their behaviour towards using doggy bags (leftovers from dining out) (Mirosa, Liu, & Mirosa, 2018). While another study identified that behaviour change interventions should appeal to the targeted audience's personal values in order to improve the effectiveness of the intervention (Mirosa, Munro, Mangan-Walker, & Pearson, 2016). However, the study also suggested providing additional information and raising awareness about food waste behaviour, as suggested by other international studies, referred above. A recent study (Makhal, Thyne, Robertson, & Mirosa, 2020) concluded that students (from age 5 to 11 years) can accept imperfect looking fruit and vegetables and their acceptance of these sub-optimal food could be used to address food waste of this specific food group. The study suggested that there was a potential in addressing the sustainability problem of these foods through students who can then in turn influence their families' buying habits.

Whilst learners may be pre-disposed or interested in developing literacy towards an issue like food waste, there may be some barriers that prevent them from fully developing their literacy by impacting on their attitudes and values and specifically on their potential behaviour. These barriers may thus be individuality, practicality or responsibility (Kollmuss & Agyeman, 2002), and fixed and difficult to change or flexible and easier to change (Stangherlin & de Barcellos, 2018).

As mentioned above, Food Waste Literacy also needs to be developed which would specifically encompass food waste. My proposed definition for Food Waste Literacy (FWL) would be

‘literacy for the judicious use of food by acquiring the ability to use the food produced efficiently, with an understanding of concepts ranging from the production to consumption of food.’ Food Waste Literacy is important to conserve energy and natural resources, and to be able to support the communities which do not have a steady supply of food. Food Waste Literacy is necessary to mitigate some of the adverse effects of food waste by humans; on our environment and should form a part of environmental education. Food Waste Literacy should be a crucial determinant of environmental sustainability and social equity. To date, there appears to be little in the literature about Food Waste Literacy. In order to develop Food Waste Literacy, education processes are deemed important to develop food waste knowledge, attitudes and values, and behaviour (Kaur, Dhir, Talwar, & Alrasheedy, 2021; Porpino, 2016). Whitehair et al. (2013) have also suggested education and communication to be the most effective approaches for edible food waste behaviour change. Intervention has been specifically found to be useful and effective in changing food waste behaviour (Boulet, Grant, Hoek, & Raven, 2022b; Soma, Li, & Maclaren, 2020). As the focus of this research is involving Food Waste Literacy at the intermediate level, curriculum Year 7 of schooling in New Zealand, the next section now reviews intermediate schooling and associated teaching and learning aspects, beginning with an overview of the New Zealand school system.

2.4 New Zealand education system and Food Waste Literacy

2.4.1 Education in New Zealand

The education system of New Zealand reflects its unique and diverse society which welcomes different abilities, ethnic groups and nationalities, and progressive ideas about teaching and learning. *The Education and Training Act 2020* (Ministry of Education, 2020a) aims to give all learners a high-quality, culturally responsive, seamless and inclusive education, in all the stages of learning, right through the employment. Under this *Act*, all students have the right to attend school fulltime. Formal education in New Zealand spans three levels:

1. Early childhood education- from birth to school entry age
2. Primary and secondary school education – from 5 to 17 years of age
3. Tertiary education – higher and vocational education

I will only focus on school education as my study is based in intermediate level of schooling. There are three different classifications of school depending on the school structures, gender

composition and sources of funding. There are 13-year levels, with primary years typically from 1 to 8, Years 7 and 8 make the intermediate schooling, and Years 9 to 13 form the secondary education.

2.4.1.1 The New Zealand Curriculum

There are two general kinds of schools which differ by the medium of instruction. One kind has English as their medium of instruction. The other has *Te Reo Māori* as the medium of instruction and students are taught all or some curriculum through Māori language. There are also some English medium schools which have a Māori immersion unit within them, where students learn through both English and *Te Reo Māori*. In terms of policy, there is *The New Zealand Curriculum* (NZC) which is followed by the schools that teach in the English language, while schools using the Māori medium of instruction use *Te Marautanga o Aotearoa* (a curriculum based on Māori values) (Ministry of Education, 2018b). I am not providing details about the *Te Marautanga o Aotearoa curriculum*, as this study was not carried out in a Māori medium school.

The New Zealand Ministry of Education states that *The New Zealand Curriculum* has an overall vision and a blend of principles, values, key competencies, and learning areas (Ministry of Education, 2017). Of interest to this study, is the part of the vision of *The New Zealand Curriculum* where students are encouraged to be actively involved in the social, cultural, and environmental well-being of New Zealand, and to develop into lifelong learners. This vision is supported by a set of principles which put students at the centre of teaching and learning. These principles engage and challenge students in a curriculum which is forward looking and inclusive, and which affirms New Zealand's unique identity. The principles relevant to this study are centred around the cultural diversity, learning to learn, community engagement, and focus for the future (Ministry of Education, 2007). These principles will form the basis of the planning of my study to develop and promote Food Waste Literacy of the students. The values which the students are encouraged to learn include equity, community and participation, and ecological sustainability. Through their learning experiences in this study, students were able to develop their abilities to make ethical decisions around food waste and act on them. By learning to deal with overbuying of food, students explored the value of equity. Food Waste Literacy can play an important role in achieving the vision of lifelong learners relating to others.

The values, the principles, and the overall aim of *The New Zealand Curriculum* are supplemented by the key competencies. The key competencies are capabilities for living and lifelong learning. They are key to learning in every learning area. There are five key competencies which find a place in the curriculum. They are thinking, managing self, relating to others, using language, symbols, and texts, and participating and contributing. Participating and contributing is education for democratic citizenship (Ministry of Education, 2017). Food Waste Literacy can be an effective means of relating to others and for participating and contributing.

The New Zealand Curriculum prescribes 8 learning areas. They are English, the arts, health and physical education, learning languages, mathematics and statistics, science, social science, and technology. Each learning area has prescribed achievement objectives which set out desirable levels of knowledge, understanding, and skills which represent progress towards broader outcomes that ultimately amount to deeper learning (Ministry of Education, 2007). I have explored these learning areas in relation to Food Waste Literacy below in the section 2.5.1. *The New Zealand Curriculum* also includes ‘future focus issues’ which makes connections between the learning areas, values, and key competencies, and they are relevant to students’ futures. Sustainability, citizenship, and globalisation are some of the future focus themes (Ministry of Education, 2007) and Food Waste Literacy could fit within all these foci. Developing Food Waste Literacy impacts the sustainability of food, helps in developing food citizenship and contributes to well-being of society, and helps in exploring students’ roles as a part of global community towards reducing food waste.

However, in schools, teachers and learners have to agree on what should be learned (curriculum), how would the best teaching and learning take place for different learners within any classroom environment (pedagogy) and how learning would be determined and future learning informed (assessment) (Hayward, Higgins, Livingston, & Wyse, 2016). Hence, any curriculum implementation is dependent on the kind of pedagogy that delivers that curriculum (Gregory, 2001). The next section reviews the literature on pedagogy and especially the pedagogy of environmental education.

2.4.1.2 Pedagogy

Pedagogy can be described as the heart of teaching. It is about principles of instruction, teaching methods and assisting students through interaction and activity in the ongoing academic and social events taking place in the classroom (Pritchard & Woppard, 2010, p. 45). Leach and Moon (2008, p. 6) have explained pedagogy as a “dynamic process, informed by theories, beliefs, and dialogue, but realized in the daily interactions of learners and teachers in real settings”. This explanation is seen as a dynamic process (Waring & Evans, 2014) where it is constantly reworked by learner and teacher, and the learner is active and central in the whole process being enabled to make an informed and willing contribution to a democratic society. Teachers can achieve meaningful learning for their students by being conscious of learning theories that they use. There are many learning theories and each emphasizes different aspects of learning (Waring & Evans, 2014). Learning theories are a source of verified instructional strategies, techniques and designs which inform a suitable pedagogy (Ertmer & Newby, 2013). I now examine some theoretical ideas of learning that could inform pedagogies that may be useful in the development of Food Waste Literacy (FWL).

For many years, behaviourism was the leading theoretical approach to education (Schunk, 2012). According to the behaviourism learning theory, knowledge is objective and verifiable and, learning is seen as change in behaviour. Students are passive receivers, while the teacher’s role is to transmit knowledge and skills using reinforcements and assess students through testing (Waring & Evans, 2014). Behaviourism thus viewed students as unreflective responders and there is no subjective element to learning in terms of how information is interpreted, used or understood (Boghossian, 2006). I found that, behaviourism was not aligned with my study which would explore and assist in the development of Food Waste Literacy amongst students. I had concerns regarding the use of this theory by teachers to develop Food Waste Literacy in their classrooms, as I felt that it would impede the understanding and conceptual development amongst students. Therefore, I looked deeper into the evolution of the learning theories.

In the early 1990s, the environmental education theorists and researchers started turning towards another learning theory, constructivism (Eames et al., 2006). This learning theory was based on the premise that knowledge is actively constructed by the learner and not received

passively (Ertmer & Newby, 2013). According to constructivists, learning takes place when new information is built and added into students' current structure of knowledge, understanding and skills (Pritchard, 2017). Teachers act as guides and help students to create their own learning in response to interactions with environmental stimuli. The teacher presents the information in different ways to provide different conceptual perspectives, supporting the use of problem-solving skills allowing students to go beyond the information provided (Ertmer & Newby, 2013). Students are the centre of knowledge and each student's subjective experiences have a special and unique meaning (Boghossian, 2006). Klein and Merritt (1994) found parallels between environmental education and constructivism as both philosophies require students to take an active part in learning and building on their factual knowledge to improve their investigation and critical thinking skills (p. 20). Kanselaar (2002) stated that there are two perspectives of constructivism - cognitive and socio-cultural. The central idea in cognitive constructivism is based on the work of Jean Piaget. Piaget asserted that learning does not occur passively, instead it occurs by active construction of meaning (Kamii & Ewing, 1996). Piaget (1977) advocated that a state of imbalance is created when learners encounter any experience or a situation that challenges the way they think. The learners either alter their thinking to restore equilibrium by assimilating the new knowledge into the pre-existing knowledge or use accommodation by restructuring their pre-existing knowledge to a higher level of thinking. Piaget thus implied that the learners' previous knowledge influences their new knowledge. The role of the teacher is thus to facilitate the discovery of new knowledge by providing the necessary resources and by guiding learners in their journey of assimilating new knowledge. The teacher must keep in mind the pre-existing knowledge of the students while constructing the curriculum and while structuring, sequencing and presenting new material. Another form of constructivism - social constructivism was developed by Vygotsky who advocated that learning did not simply consist of assimilation and accommodation of new knowledge by learners: learning takes place in the context of social interactions. Vygotsky (1978) believed that knowledge is not simply constructed, it is socially co-constructed. Therefore, learning is the rich interaction with other people with different or similar perspectives (Woo & Reeves, 2007). Learners' construction of knowledge is thus the product of social interaction, interpretation and understanding (Adams, 2006). Social constructivist believe that learners can better understand concepts and ideas in the company of teachers or peers, who are more advanced in their meaning-making (Woo & Reeves, 2007). Social constructivist pedagogy (Adams, 2006) is hence based around these common principles: -

1. focus on learning and not on performance,
2. viewing students as active co-constructors of meaning and knowledge,
3. a teacher-student relationship built on guidance and not instruction. The key requirement for teachers is scaffolding the process of the learning journey for learners.
4. promoting assessment as an active process of discovering and acknowledging shared understanding.

Hence, according to Klein and Merritt (1994), the four main components of a constructivist lesson which can be used by a teacher are introduction of a real life problem by the students or teacher for the students to resolve, student-centred instruction facilitated by the teacher, productive group interaction during the learning process, and genuine assessment and demonstration of student progress. A constructivist approach in Environmental Education was thus found to be useful to enhance students' action competence (Eames et al., 2006). Constructivism learning theory aligns perfectly with the aim of my study of exploring and developing students' Food Waste Literacy.

In the context of New Zealand, *The New Zealand Curriculum* promotes several teaching approaches as evidence of effective pedagogy. According to *The New Zealand Curriculum* (Ministry of Education, 2017), the use of an effective pedagogy has a positive impact on students' learning. I settled on the use of an inquiry-based approach for exploring and developing Food Waste Literacy among students. Inquiry-based pedagogy is centred around students' curiosity and openness to wonder about the world around them, and is based on the principles of social constructivism (Walker & Shore, 2015).

In the next section, I review the literature on inquiry-based approach and how it may be useful in my study in exploring and developing Food Waste Literacy among students.

2.4.1.3 Inquiry-based learning

Teaching and learning in a social-constructivist environment needs to encourage knowledge formation (Walker & Shore, 2015). Inquiry-based learning has a strong focus on students discovering and building their own meaning by posing questions, co-operating and solving

problems together and with their communities in real, shared learning experiences (Ministry of Education, 2018a). Inquiry-based learning and experiential learning are both means of connecting real life situations and classroom knowledge by the students. The inquiry approach helps to develop independent academic competence and also life skills in the learners (Kuhlthau, Maniotes, & Caspari, 2015). Inquiry based learning, which has sufficient support by the teacher, is positive for the students' learning, knowledge development, reasoning skills, motivation and self-regulated learning (Dobber, Zwart, Tanis, & van Oers, 2017). Further, inquiry learning helps in creating an authentic learning environment and adds to the students' motivation to learn (Abdi, 2014; Aulls, 2008). The common models of inquiry are open or full inquiry, Guided-Inquiry or directed inquiry (Martin-Hansen, 2002):

1. Open inquiry is a student-centred approach where students ask the questions that guide their own investigations.
2. In Guided-Inquiry, the teacher usually helps students develop inquiry investigations in the classroom. Students may then assist the teacher with deciding how to proceed with the investigation (Martin-Hansen, 2002, p. 35). Guided-Inquiry is a pedagogical learning approach that involves students to find out information from different sources to have more understanding of a particular concept in a curriculum (Kuhlthau et al., 2015). Guided-Inquiry can engage, interest, challenge and motivate students to question, explore and make new ideas (Chu, Tse, & Chow, 2011; Kuhlthau et al., 2015).
3. Directed inquiry, also referred to as structured inquiry, is a Guided-Inquiry mainly directed by the teacher. According to Jang-Jones (2019) in using the open inquiry method, the students take more time to inquire into any element of scientific knowledge, and processes and procedures take more time in comparison to teacher-directed inquiry and teaching. Therefore, the open inquiry method may simply be slower to build students' knowledge and skills (Jang-Jones, 2019). Moreover, open inquiry is resource intensive as it needs plenty of teacher planning time, school materials, and depends on productive learning behaviour in class and appropriate amount of guidance by the teacher. However, in teacher-directed inquiry, the students are provided specific resources in a sequential manner along with the challenging questions as well as the clear outcomes (Discovery Education Science, 2018). The teacher directs students on how to interact with each resource and the order of each resource. The teacher decides on the questions to be investigated and

how they will be investigated (Dobber et al., 2017). Under this approach, students investigate a teacher-presented question through a prescribed procedure and are guided by the teacher to use those wide variety of resources to address questions and explore ideas to have a deep understanding for themselves (Bell, Smetana, & Binns, 2005). This approach would be useful for me in developing students' Food Waste Literacy. Students would have access to specific resources and how to use them effectively. I felt that as an outsider teacher in a school in New Zealand, I may not have freedom of unlimited time for this approach, whereas teacher-directed Guided-Inquiry would take less time.

There may be up to eight phases in any inquiry, namely open, immerse, explore, identify, gather, create, share and evaluate (Kuhlthau et al., 2015). I considered using all these phases of inquiry learning in my Guided-Inquiry. According to Maniotes (2016), the 'Open' phase is the one which opens the inquiry with something that generates curiosity about the upcoming inquiry. The 'Immerse' phase guides the learners to think about what they already know and what they find interesting, curious, or difficult to understand. In the 'Explore' phase, the learners explore all the different sources of information and start framing their inquiry questions. In the next phase, Identify, the learners identify the inquiry questions about the emerging themes or interesting ideas which they have explored and immersed themselves in. The 'Gather' phase involves more guidance by the teachers so that the learners collect information which helps in understanding their inquiry questions. The 'Create' phase involves guiding the learners to create and present their understanding in an interesting and clearly articulated way which shows what they have learned in their inquiry process. The 'Share' phase is the culminating phase where the students share about their learning with other students. In the end, the 'Evaluate' phase closes the inquiry process where the students reflect on the content and the process. This self-reflection by the students reinforces content learning and guides the next inquiry process. Overall, the inquiry process focusses on students' self-reflections as they ask questions, discover answers, and communicate their understanding (Lawson, 2014).

The use of inquiry approach on the academic achievement of the students has been well researched. For example, in a case study undertaken in a high school in the USA in 2017, it was found that teachers and students felt that Guided-Inquiry design provides a new 21st century learning design (Heinström & Sormunen, 2019). Students valued the close guidance

by teachers throughout the process and were motivated throughout the inquiry process. These findings were also mirrored in a study undertaken in a primary school in Iran (Abdi, 2014). The findings concluded that the students who were instructed through inquiry-based learning achieved higher scores than the ones who were instructed through traditional methods. In another small-scale study, for instance, Torrington (2013) argued that there was a huge improvement in students' reading skills as a result of the intensive individual conferencing with students and explicit lessons in locating and comprehending information during the Guided-Inquiry process. Similarly, researchers argue that the use of a Guided-Inquiry approach helps in improving the understanding of the scientific concepts (Kathy, Atwood, Christopher, & Sackes, 2010). These studies provide insight into how the use of inquiry may affect the academic performance of the school students in diverse ways.

As the study is focussed on the intermediate level of schooling, this literature review now specifically focuses on Year 7 (ages 11-12) education in New Zealand.

2.4.2 Intermediate schooling in New Zealand

Intermediate schools are unique to New Zealand, as many countries like Australia have middle schools but New Zealand is the only country to have two-year intermediate schools (Education Central, 2018). It was the *Atmore Report* published in 1930 that supported the establishment of intermediate schools (McGuinness Institute, 2016). A comprehensive report by Lucic' (2013) informed that, by the end of 1930's, five intermediate schools had been established, with the first one being in Auckland in 1922. The *Currie Report* (1962) and the *Watson Report* (1964) further supported the concept of intermediate schooling. According to the report by Lucic', as the original idea for intermediate schools was to bridge primary and secondary schooling, these historic 'preparatory' and 'transitional' functions of the intermediate schools have remained as their most important functions and may remain so for the foreseeable future too (Lucic', 2013). As of July 1 2017, there were 117 intermediate schools in the country with the last one started being *Somerville Intermediate* in Auckland in 1997 (Education Central, 2018).

The students in the intermediate years of schooling are young adolescents, generally aged between 11 to 13 years old. These years are filled with rapid changes and challenges. It is a transitional phase for the students between primary and secondary school. These years are like ‘a riddle, wrapped in a mystery, inside an enigma’ (Lucic’, 2013, p. 13). Generally, intermediate schools are run in the same manner as primary schools, as there is a homeroom teacher who is responsible for teaching the core subjects. There are specialized teachers for non-core subjects. Students are exposed to all learning areas of the curriculum. Students are challenged to develop curious and analytical minds and dispositions in preparation for the next stage of schooling that involves more independent learning (Kiwi Families, 2018). Intermediate schools thus provide the familiarity of the primary school’s integrated curriculum and introduce the specialist teaching of secondary schools (Ward, 2000). However, there have been arguments for moving towards four years of middle schooling as changing schools after just two years can add stress and anxiety for many adolescents (Donaldson, 2018). *The Tomorrow’s Schools Review* had recommended a longer period of middle schooling (Years 7-10) as it provides greater stability for the students and enables better support for the well-being of the students (Tomorrow’s Schools Independent Taskforce, 2018). For students who attend intermediate schools, succession from primary school to secondary school involves two transitions in successive years which is seen as unnecessarily disruptive of learner/ākonga pathways (Tomorrow’s Schools Independent Taskforce, 2018, p. 61). The report has also suggested an alternative option that all primary schools in New Zealand should retain their students to the end of Year 8 to provide more stability in early adolescence.

Studies of middle schools and their associated challenges have emphasized parental involvement, among other important factors, to smooth this transition phase of students (Elias, Patrikakou, & Weissberg, 2007; Hornby & Witte, 2010). Elias *et al.* (2007) have suggested that middle school is the time of peak referral for mental health problems as children are making the transition to adolescence as well as transition from primary school, and parental involvement is specifically crucial at this time.

The students at intermediate level of schooling are young adolescents. In adolescence, children become able to think about ideas and about things they cannot see or touch. They become better able to think through problems and visualise the consequences of different actions or different

points of view (U.S. Department of Education, 2005). The cognitive changes they undergo makes them better equipped to learn more advanced material in school. This is the time when the students can be provided more opportunities to learn about a range of issues under the umbrella of Environmental Education. The next section reviews the Environmental Education in New Zealand in the context of intermediate schools.

2.4.2.1 Environmental Education in New Zealand

The development of Environmental Education (EE) in schools in New Zealand has followed a pattern of evolution, similar to many western countries (Eames & Barker, 2011). It was in 1999, in New Zealand that the Ministry of Education published *Guidelines for Environmental Education in New Zealand Schools* to provide guidance for the implementation of EE. Environmental Education was seen as a way to promote the need for personal initiatives and social participation to achieve sustainability. Hence, these guidelines can also lay a foundation for developing Food Waste Literacy among students. I present below the aims of EE provided by the Ministry of Education (2015b) and how they can be used to develop Food Waste Literacy. The aims are: -

1. to develop awareness and sensitivity to the environment and related issues. This awareness can be an awareness about food waste also and may develop students' Food Waste Literacy.
2. to develop knowledge and understanding of the environment and its impact on the people. Students can have knowledge of food waste and its social, economic, and environmental impacts.
3. to develop attitudes and values towards the environment. Attitudes and values towards food waste can be developed creating Food Waste Literacy.
4. developing skills of identifying, investigating, and solving the environmental concerns. This can also include the issue of food waste.
5. developing a sense of responsibility through participation and action, either individually or collectively, towards environmental issues. Students can develop a sense of responsibility towards food waste thus sharing the same aims of Environmental Education.

Similarly, the four key concepts of EE in the context of New Zealand (Ministry of Education, 2015b) can also be used to develop Food Waste Literacy. These key concepts provide a framework for learning about: -

1. interdependence between all living things (including people) and their physical environment. Food Waste Literacy can be an extension of the same concept where students learn about food equity and the environmental impact of wasting food.
2. sustainability of resources in New Zealand which must be shared and managed equitably to maintain and improve the quality of the environment. Students can learn about the loss of resources when food is wasted.
3. biodiversity and interrelatedness of the biological world and the impact that the people have had on living systems as about four hundred species of indigenous plants and animals in New Zealand are listed as threatened. Students can learn about how food waste in landfill can contribute to production of methane and an increase in global warming. Also, students can learn about the impact of global warming on the world and specifically on New Zealand.
4. personal and social responsibility for action towards a range of environmental issues. Students can learn about reducing food waste at individual and collective levels.

The Ministry of Education also supported the three key dimensions of EE - education in the environment, education about the environment and education for the environment (Ministry of Education, 2015b). Education in the environment is typically based beyond the classroom where the students get an opportunity to experience first-hand in the environment but the opportunities for such experiences will be different, depending on the local environment. Opportunities to learn about food waste can also be included in these environmental education experiences. Education about the environment is affected by various factors like economic activities, cultural awareness, and ecological understandings. The National Curriculum statements provide frameworks for dealing with these factors which will help students to develop their own environmental attitudes and values. Education for the environment seeks ways in which students can make lifestyle choices which will be good for the environment and minimise the impact of their choices on the environment. Education for the environment could include ways to make better food choices which may lead to less or no food waste.

Along with the guidelines, a professional development programme to support those guidelines, and a successful non-government programme, *Enviroschools*, have also led to the development of Environmental Education in New Zealand (Eames & Barker, 2011). *Enviroschools* started as a small project in 1993 with the aim of integrating EE in response to the call from the 1992 Rio Earth Summit to ‘think globally and act locally’ (Enviroschools, 2021). It has now grown into a nationwide programme and is involved in 978 schools in the country. I decided to carry out my study in an Enviroschool as their aims and guiding principles align well with the aim of developing Food Waste Literacy among students. The *Enviroschools* have been guided by principles to create a healthy and sustainable world (Enviroschools, 2021). They are: -

1. empowered students that are enabled to participate in meaningful ways. Students will learn about food waste and should be empowered to reduce food waste.
2. learning for sustainability which involves teaching and learning that brings about sustainable outcomes. Students will learn about sustainable alternatives to food waste like not overbuying of food.
3. respect for the diversity of people and cultures which leads to participatory decision making and collaborative action. Students will learn about food choices being influenced by cultures and their outcomes on food waste.
4. sustainable communities that act in ways that maintain the health and viability of our environment.

As mentioned in the previous section on Environmental education, as a result of the initiatives in the 1990s, Environmental Education, globally, started focussing on environmental sustainability for the long term, rather than just looking at immediate environmental issues (Tilbury, 1995). In the context of New Zealand, it can be clearly seen that *The New Zealand Curriculum* positions sustainability as an interdisciplinary concept that could be addressed through all learning areas (Ministry of Education, 2015a). Sustainability ideas are included in many of the components of the curriculum i.e. the vision, the principles, the values, and the key competencies (Ministry of Education, 2007). This unique position of sustainability allows it to be approached through various learning areas and not keeping it confined to any particular learning area. This approach provides multiple opportunities for rich learning in everyday situations (Ministry of Education, 2015a). The core of what has been known as Education for Sustainability (EfS) is that students take informed actions to address sustainability issues and also participate in creating a sustainable future (Ministry of Education, 2015a).

The Ministry of Education (2015a) provides guidelines for what EfS is and what a sustainable school is. Accordingly, in a sustainable school, firstly, ‘people’ work together, keeping the bi-cultural heritage of New Zealand in mind. Secondly, ‘programmes’ focus on taking action by the students to learn about the reality of the sustainability issues of the community. Thirdly, schools have a culture of sustainable ‘practices’ to make a more resilient community. Lastly, a ‘place’ is created where students and their community work together to reduce their impact on the Earth to sustain it for the future generations (see Figure 2.2).

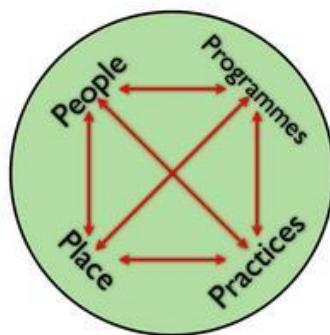


Figure 2.2 A sustainable school (Ministry of Education, 2015)

My study is aimed at developing Food Waste Literacy among students, where students and teachers (people) would work together to develop this literacy. Students would learn about food waste during my study (programme) in their school. As a result of this study, the school may introduce or promote ways of reducing food waste (practices) at school, like, sharing extra food or donating to food banks. Lastly, students and community can create compost bins or worm farms (place) for food waste. Thus, specifically in the context of intermediate schools, EfS offers ways to enhance the social, cultural, economic, and environmental well-being of New Zealand.

Bolstad, Joyce & Hipkins (2015) carried out a study to update a national evaluation project of Environmental Education which had been conducted in 2002-2003. Besides other inputs, the 2015 update also included some challenges for the inclusion of EfS in the learning areas. One challenge had been how to ensure that teachers across all years are able to integrate EfS into school curriculum and help to realise the aims of *The New Zealand Curriculum*. Another challenge that had been stated was how to monitor and evaluate progress in EfS given the decentralised nature of the school curriculum design. The report provided many suggestions

about implementing EfS. One of the suggestions was to take new steps to build a more connected and future oriented EfS system, and research about the effectiveness of EE in developing students' action competence and decision making about present and future environmental issues. Despite these suggestions, in a 2019 report of Ministry of Education, New Zealand, it was mentioned that New Zealand's 15 year old students had been reported as having a low awareness of key environmental problems in a 2015 Programme for International Student Assessment (PISA) report when compared with their peers in over 70 countries (Ministry of Education, 2019a). In the light of this report, it becomes worthwhile to explore and develop Food Waste Literacy of intermediate level students who are usually 11-12 years old.

The next section reviews the literature on Food Waste Literacy in New Zealand schools.

2.5 Food Waste Literacy in intermediate schools

2.5.1 Food waste in *The New Zealand Curriculum*

The New Zealand Curriculum was studied in detail to explore the opportunities for teaching and learning about food waste. *The New Zealand Curriculum* offers 8 levels across 13 years of schooling (Ministry of Education, 2007, p. 44). The intermediate years lie generally in level 4 as can be seen in the figure below (see Figure 2.3).



Figure 2.3 Years and curriculum levels (Ministry of Education, 2007, p. 44)

Therefore level 4 achievement objectives of the Science and Social Sciences learning areas were specifically reviewed to examine their contents especially in the context of Environmental Education, Environmental Literacy, Sustainability Education, and Food Literacy. Upon

carefully examining these learning areas in level 4, I found that learning about sustainability issues can be seen within the achievement objectives of each of these learning areas.

- The achievement objective in Science of participating and contributing, aims at students using their growing science knowledge for various issues concerning them. Students should also explore various aspects of an issue and make decisions about possible actions. Learning about sustainability and Food Waste Literacy could be seen in ‘Earth systems’ under ‘Planet Earth and Beyond’ strand. Learning about Earth’s resources is learning about sustainability and also developing Food Waste Literacy as food waste is also waste of our natural resources.
- The achievement objective in Social Science that students will gain knowledge, skills and experience of understanding, aims at students’ understanding that events have causes and effects and that people can participate individually and collectively in response to community challenges. Understanding about food waste and developing Food Waste Literacy could be seen in decisions about food waste and its multifaceted impacts, and students’ participation in working towards mitigating food waste.

Thus, there are various opportunities in Science and Social Sciences for learning about sustainability, food waste and Food Waste Literacy, which can be created using these achievement objectives. There could be an emphasis on engaging in food waste issue and developing Food Waste Literacy by including it with multiple learning areas in *The New Zealand Curriculum*.

2.5.2 Food Waste Literacy in schools

With regards to the inclusion of food literacy in the school curriculum, there have been a few studies published about food literacy in schools globally (Fordyce-Voorham, 2015; Martin, 2018; Nanayakkara et al., 2018; Ronto et al., 2017; Thomas, 2011) and in New Zealand (Barback, 2015; Davis, 2017), but the focus of all of this research has been on the health and nutrition aspect of food literacy. About the inclusion of food literacy in the curriculum in senior secondary schools in Victoria, Australia, the food system professionals felt that the curriculum should have more emphasis on primary food production, and nutrition awareness and promotion (Nanayakkara et al., 2018). Davis (2017) studied food literacy of Year 6 New Zealand school children, however the study was aimed at establishing a baseline measure of the practical food skills as a component of food literacy. Similarly, a media release by the New

Zealand Food and Grocery Council (FGC) in 2016, centred around food literacy for the prevention of obesity and other health-related issues amongst the New Zealand population (FGC, 2016). Organisations like the ‘Garden to Table Trust’ have been pursuing the cause of food literacy becoming a part of the school curriculum since 2008, to tackle obesity and food nutrition (Barback, 2015). The Garden to Table programme is integrated with the curriculum and gives students the opportunity to learn about food and how it is grown. In a study undertaken in 2013, it was concluded that the Garden to Table programme had improved children’s knowledge and attitudes about cooking and gardening (Wakefield, 2013).

However, I have been unable to find any study relating food literacy specifically to food waste, especially in the context of New Zealand. The literature review revealed that there are major data gaps in the knowledge of Food Waste Literacy (FWL) and further research in this field is urgent. The issue of food waste has significant social, economic, and environmental consequences globally and for New Zealand. Inclusion of food waste into food literacy and working towards creating and researching Food Waste Literacy may help in reducing food waste.

2.6 Chapter Summary

Food waste is a global phenomenon, including in New Zealand, which is essentially a waste of our precious natural resources. It is a waste of human effort and money in producing, harvesting, transporting, and making available the food produced for people when it is discarded or thrown away uneaten by them. It also has various environmental impacts when it is thrown away in landfills and produces leachate and harmful greenhouse gas methane. It is morally and ethically irresponsible to waste food when there is a large part of the world population which is underfed or starving. There are some not-for-profit food rescue organisations in a few countries which are working towards creating awareness concerning reducing food waste. Some countries have also laid down policies to reduce food waste in their countries and are supporting the non-government organisations to tackle this problem. There are numerous reasons for food waste at different levels of the Food Supply Chain. However, the problem of food waste at the level of individuals may be addressed through creating positive attitudes, dispositions, and behaviours towards saving and using food efficiently.

The literature review has established the role of Environmental Education in developing environmental awareness, attitudes and values, and behaviour. Environmental Education may have a transformative approach leading to the development of critical and constructive learners. Employing Guided-Inquiry learning may promote critical thinking skills in students, and they may make informed decisions based on their understanding of environment and sustainability. Environmental Education should contribute towards the growth of individuals' environmental literacy and should emphasise on food literacy too. The concept of food literacy is still emerging and evolving and most of the definitions include health and nutrition aspects of food. However, there is a scarcity of literature about food waste being studied as an element of food literacy. Food Waste Literacy (FWL) can thus be a new and added dimension of food literacy to manage the specific cause of food waste. Food Waste Literacy can be a part of the school curriculum to fulfil the vision of Sustainable Development Goal 12.3 of the United Nations (UN) which aims at halving the per capita global food waste at the consumer level by 2030. Food Waste Literacy can be a step forward towards creating and inspiring food citizenship among students. In the context of New Zealand, Food Waste Literacy can be easily integrated into the various curriculum levels of the learning areas of Science and Social Sciences. A conceptual framework for this research was designed integrating the ideas of environmental education and food literacy and is presented in the next sub-section.

2.7 Conceptual Framework for this Study

Developing an appropriate and relevant conceptual framework is an essential part of any research and provides a much-needed blueprint for the research. A conceptual framework provides a theoretical overview of the intended research and order within that process (Leshem & Trafford, 2007). It also provides a scaffolding within which strategies for the research design can be determined (Leshem & Trafford, 2007).

The conceptual framework drawn from the literature (Hollweg et al., 2011; Hungerford & Volk, 1990; Roth, 1992), which informed my study, was based on the proposition that one of the goals of Environmental Education is developing Environmental Literacy. Environmental Literacy is a continuum of competencies which draws upon knowledge, attitudes and values, and behaviour (Roth, 1992). The literature review also established that developing Food Waste Literacy, as an extension of Food Literacy and Environmental Literacy, may help in mitigating

the food waste problem. An intervention approach using guided inquiry could help in the development of Food Waste Literacy.

Based on the concepts within Environmental Education, Environmental Literacy, and Food Literacy, the following conceptual framework was thus designed for this research to develop questions and guide the research (See Figure 2.4).

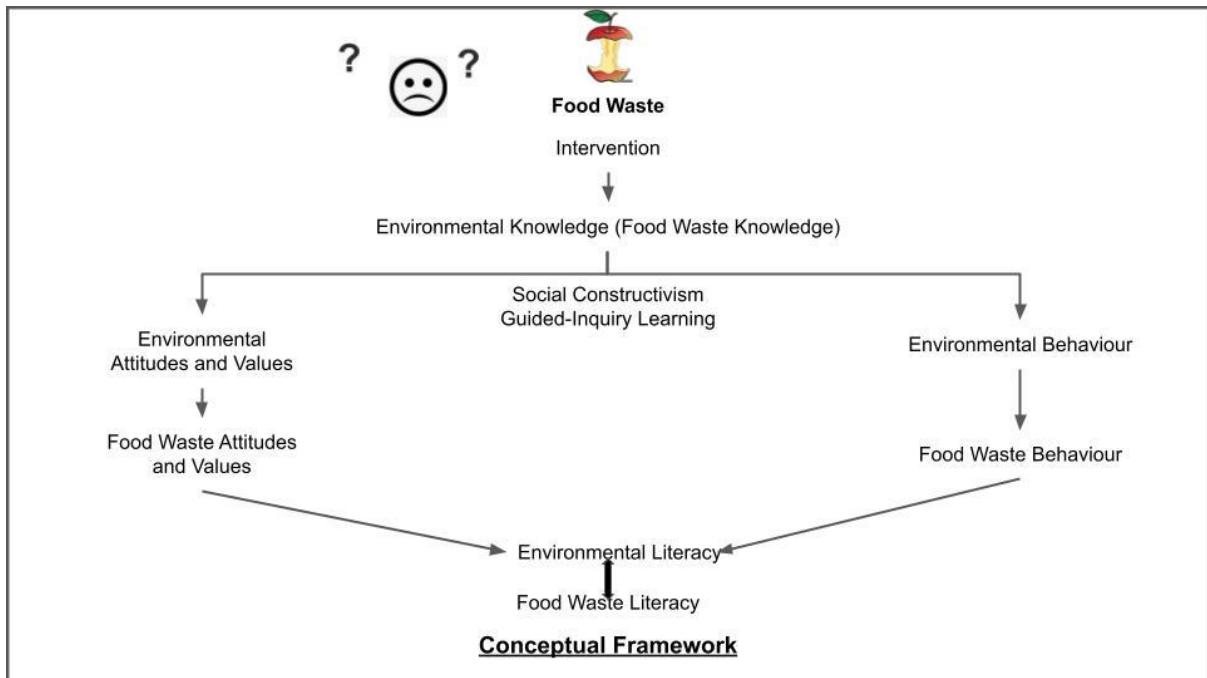


Figure 2.4 Conceptual framework of Food Waste Literacy

The aim of this study was to explore and develop Food Waste Literacy (FWL) among intermediate school level students of New Zealand. The FWL was to be developed using the social constructivist approach which emphasises that individuals learn when they actively construct knowledge and understanding and social interactions strongly influence this process (Walker & Shore, 2015). The Guided-Inquiry pedagogical approach facilitated the pathway to the development of environmental attitudes and values, and behaviour in the context of food waste, as Guided-Inquiry approach has been found to be effective in developing students' Environmental Literacy (Amiroh, Irawati, Suhadi, & Mardiyanti, 2021). The findings may inform curriculum decision makers of the country and the teachers so that they can be more effective in raising levels of Food Waste Literacy among the students. This conceptual framework helped me in focussing on the importance of

researching Food Waste Literacy and generating the research design and methods, in the context of this research. The next chapter presents the methodology and the methods used in this research.

Chapter 3: Methodology

3.1 Chapter Overview

This chapter discusses the methodology used in this research. The initial section presents the aims of the study and the research questions. The next section presents the various paradigms which I considered for my study before I settled for the interpretivist paradigm in the research. This is followed by the case study research methodology used in this study, and the research methods and research design which were employed. Next, there is a section on data analysis describing both quantitative and qualitative data analysis. The validity and the reliability of the study, and the ethical considerations of this study are discussed in the final sub-sections. The chapter concludes with a summary of the methodology used in the study.

3.2 The aims and research questions of the study

The aim of this research was to explore the current status of the Food Waste Literacy amongst intermediate aged students in New Zealand and to explore ways to enhance this literacy development.

Given the scarcity of research done in the field of Food Waste Literacy (FWL) in schools in New Zealand, the key focus for this research was based around these three questions:

1. What is the Food Waste Literacy of Years 7 students in a New Zealand school?
2. What kind of intervention might be designed and implemented to engage Year 7 students in developing Food Waste Literacy?
3. How does an intervention activate Year 7 students' inquiry and decision making in Food Waste Literacy?

The next section examines the methodologies that were considered for carrying out the research and then the case study methodology that was adopted for this study.

3.3 Methodology

Methodology refers to the plan of action which lies behind the choice and use of particular methods (Crotty, 1998, p. 3). Guba and Lincoln refer to methodology as “how can the inquirer go about finding out whatever he or she believes can be known?” (Guba & Lincoln, 1994, p.

108). Methodology guides the research plan and ultimately determines how the data will be collected and analysed. Methodology is a way to systematically plan and execute the various steps to study the research problem which is well supported by the logic behind them (Kothari, 2004). It includes assumptions made, limitations encountered and how they were minimised (Kivunja & Kuyini, 2017, p. 28). In relation to my study, the methodology will be guided by the questions like - why did I choose to use an intervention strategy to explore and improve Food Waste Literacy of the students, which research approach would be appropriate - qualitative, quantitative or mixed methods and which methods will be suitable for data collection?

A methodology's focal point is to make a link between the research and establishing a suitable research paradigm. A research paradigm is a set of common beliefs and agreements shared by researchers regarding how problems might be understood and addressed (Kuhn, 1970). In other words, a paradigm is a way of perceiving, thinking and doing associated with a vision. Different research paradigms influence the development of a framework for the research (Brundrett & Rhodes, 2013). A paradigm provides a conceptual lens through which the researcher looks at the methodological aspects of the research to decide the research methods to be used and how the data will be analysed (Kivunja & Kuyini, 2017, p. 26). The various dimensions of a research paradigm are generally ontology, epistemology, methodology, and axiology (Creswell & Poth, 2016b). Ontology is concerned with the nature of being and matters related to truth and reality. It relates to the 'what' of being researched. Ontological assumptions are about the nature of reality and the nature of things (Cohen & Crabtree, 2006). In the context of my research, ontology implies a focus on the nature of reality in respect to the Food Waste Literacy of the students. Epistemology is about the nature of knowledge and "how we know what we know" (Crotty, 1998, p. 8). Epistemological assumptions arise from ontological assumptions but refer to the construction and production of knowledge (Brundrett & Rhodes, 2013). In relation to my study, epistemology refers to, how do I explore the students' awareness, attitudes and values, and behaviour towards food waste. Axiology focuses on the values and beliefs that the researchers hold. It also involves defining and evaluating concepts of wrong and right behaviour concerning the research (Kivunja & Kuyini, 2017). This guides the direction of the research to the understanding of the world based on people's views of the world and what people see as valuable (Cohen & Crabtree, 2006). For example, in my research: what will I look at as valuable data, do I just observe the students and record their feedback in an objective

state, how will I interpret my data, or do I intend to be actively involved in their teaching-learning process and take a participatory approach?

Positivism, critical theory, pragmatism, and interpretivism have been some of the commonly used research paradigms and I decided to explore them for the suitability of my study. These paradigms are discussed in the next section along with their ontological, epistemological, axiological, and methodological positions as these four elements comprise the basic assumptions, beliefs, norms and values that each paradigm holds (Kivunja & Kuyini, 2017). I then explain why I chose interpretivism for my research.

3.3.1 Positivism

The general doctrine of positivism holds that all authentic knowledge is based on sensory experiences (Cohen , Manion, & Morrison, 2018). The ontological assumptions of positivism are that reality has an existence which is independent of the human mind and moreover, it is not possible to directly access this reality (Blaikie & Priest, 2017). Epistemologically, positivist tradition believes that procedures of natural science to discover knowledge may be directly applied to social sciences using methods of science like observation and experiment (Cohen et al., 2018). The axiological perspective suggests that the researcher is just an outside passive observer and there is no free will of the researcher. Positivist tradition argues for an external and largely singular view of an objective reality which is external to, and independent of the researcher which is open to scientific discovery and laws (Cohen et al., 2018, p. 16). Methodologically, the researcher following the positivist approach will usually gather quantitative data. They will collect data to support or refute a proposed hypothesis using experimentation, observation, and manipulation, and use statistical tools to formulate results (Creswell & Creswell, 2014).

I found myself in agreement with Cohen et al (2018, p. 15) that positivism has been criticized for many reasons including its inability to answer many open-ended, creative, and humanitarian aspects of social behaviour, which reduces the very characteristics that make humans human. I could not view my study using the positivist paradigm as it regards human behaviour as passive, overlooking individualism, and freedom. Due to these assumptions of positivism in

understanding human behaviour, I explored another epistemological viewpoint viewed as critical paradigm which argues that the social world can be understood from the viewpoint of the individuals (Cohen et al., 2018, p. 17).

3.3.2 Critical Theory Paradigm

The ontological position of the critical theory paradigm is historical realism which is the view that reality is shaped by social, cultural, political, economic, cultural, and gender values and which is crystallized over time (Guba & Lincoln, 1994, p. 109). Here the realities are socially constructed entities which are under continuous internal influences (Scotland, 2012). Epistemologically, the critical theory is transactional and subjectivist (Guba & Lincoln, 1994, p. 110). Axiologically, the critical theory findings are value-mediated, and the starting point of research is often preconceived. Critical methodology involves interrogating values and assumptions, exposing hegemony and injustice, challenging conventional social structures and engaging in social action (Crotty, 1998, p. 157). This paradigm did not provide a framework for my study as I was not hoping to study any power imbalances or seek human emancipation in circumstances of domination and oppression (Bohman, 2021). I thus explored pragmatism and its assumptions, beliefs, and norms to guide my study.

3.3.3 Pragmatism

According to pragmatism, neither the ‘truth’ about the real world can be accessed by only using a single scientific method under the positivist paradigm, nor is it possible to determine social reality as constructed under the interpretivist paradigm (Kivunja & Kuyini, 2017). Pragmatists refute the idea that truth can be determined once and for all (Pansiri, 2005, p. 197). They see truth as a normative concept and maintain that truth is what works. Moreover, the truths generated from pragmatic research are viewed as imperfect or provisional truths (Clarke & Visser, 2019). This approach advocates a non-singular reality ontology which supports that all individuals have their own, unique interpretations of reality and there is no single reality, and a value-laden axiology by conducting research that benefits people (Kivunja & Kuyini, 2017, p. 35). Thus, this ‘analytic lens’ which advocates that human actions can never be separated from the past experiences and the beliefs that have originated from those experiences (Kaushik & Walsh, 2019), and a non-singular reality ontology that there is no single reality of food waste,

did not seem appropriate for my study. Therefore, I considered another paradigm called interpretivism paradigm for this study.

3.3.4 Interpretivism

The ontological position of interpretivism is relativism. Relativism is the view that realities are in the form of multiple, intangible mental constructions which are socially and experientially based and differ from person to person (Guba & Lincoln, 1994). The realities are mediated by our senses and the realities emerge when our consciousness engages with the world and the objects in the world (Crotty, 2020). Interpretive epistemology is transactional and subjectivist (Guba & Lincoln, 1994, p. 111). The researcher and the subject of research are linked so that the findings are created as the research proceeds. Axiologically, people may construct different meaning from the same phenomenon as the researcher and the subjects of research emerge as partners in the generation of meaning (Crotty, 2020). Hence, the social world is understood from the subjective perspective of individuals who are participating in it (Cohen et al., 2018). Interpretive methodology is subjective and is aimed at understanding phenomenon from an individual's perspective (Creswell & Creswell, 2014). The individual constructions can be elicited and refined through the interactions between the researcher and the participants (Guba & Lincoln, 1994, p. 111). Interpretive methodology thus provides rich qualitative data with the researcher acting as a participant observer (Kivunja & Kuyini, 2017). This 'analytic lens' seemed appropriate for my study.

3.3.5 Research paradigm for this study

I selected an interpretivist paradigm for my study after reviewing the positivist, pragmatism and critical theory paradigms. The philosophical position of the interpretive paradigm was found to be in consonance with the aims of my study as, interpretivism looks for culturally-derived and historically-situated interpretations of the social-life world (Crotty, 2020, p. 67). Interpretivism is aimed at understanding the subjective world of human experience and my aim was to understand the students and their interpretation of the idea of food waste. The students' reality of food waste is socially constructed and differs from student to student. The viewpoint of the students about food waste had to be interpreted in their socio-cultural contexts. These contexts were different socio-economic levels and ethnic groups within the students. Based on the contexts, the students may have different interpretations of food waste. There was a context

of the students being young people and not having the agency of food decisions in all cases. My assumption in using this approach was that the students and I will be engaged in an interactive process during this study. These interactions would allow me to explore and reconstruct the multiple realities of the students' views about food waste (Kivunja & Kuyini, 2017). Moreover, the focus of my research was to explore and develop the Food Waste Literacy of the students which was consistent with 'the situatedness' of knowledge in the interpretivist approach. The findings of this study may not be universally applicable theory, but it would be rich and contextually situated understanding of the students about food waste.

As a researcher I felt that I should use mixed methods for my research approach, to gain a better understanding of students' Food Waste Literacy and contribute to advancing our understanding of the issue of food waste. The case study research approach used in this study which allows the use of multiple sources of data and methods, is presented in the next section.

3.4 Research approach

The choice of methodology for any research must be based on the aims and the questions of the research. The aim of my research was to understand the state of Food Waste Literacy of the intermediate aged students of New Zealand. I also wanted to explore the development of the students' Food Waste Literacy in response to a teaching-learning intervention. The interpretivist approach that I adopted was suitable for exploring the research questions about the students' awareness, attitudes and values, and behaviour towards food waste. I decided to use mixed methods approach for my study as using them opens the door for the of use both qualitative and quantitative methods, addressing different assumptions, and including different forms of data collection and analysis (Creswell & Creswell, 2018; Teddlie & Tashakkori, 2010). For this study I had a conviction that a collection of diverse data would provide richer understanding of the research problem rather than the exclusive use of qualitative or quantitative data (Creswell & Creswell, 2018). Accordingly, I selected a convergent mixed methods design (see Figure 3.1) in this research (Creswell & Creswell, 2018, p. 219). Both qualitative and quantitative data were collected using the same constructs around food waste. The data were analysed under three phases, as advocated under this design. The qualitative data from the focus group interviews and the questionnaire were analysed by coding the data into broad themes. Then the quantitative database from the questionnaire was analysed using

statistical tools. The third stage consisted of mixed methods analysis where the two databases were integrated (Creswell & Creswell, 2018, p. 219).

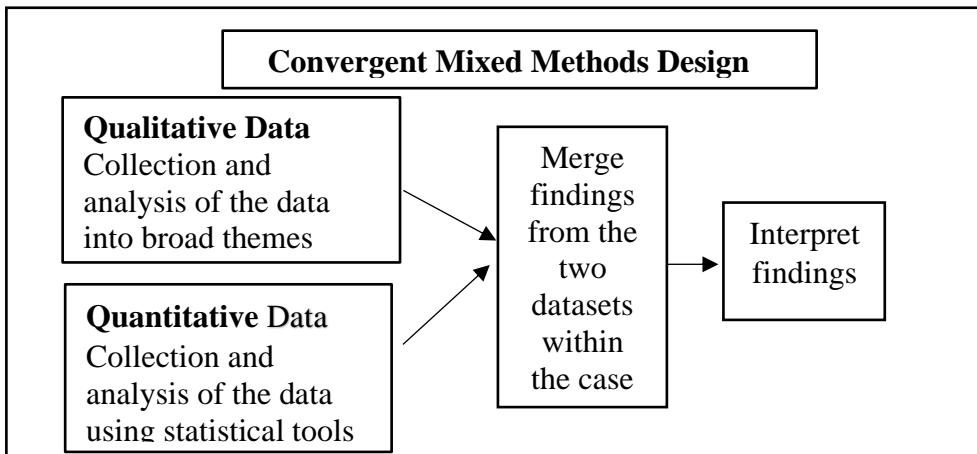


Figure 3.1 Convergent mixed methods design

3.4.1 Quantitative research approach

Gathering data in quantitative research approach often involves an experimental design, pre-test and post-test measures of knowledge, attitudes or intentions to act and data collection, which is analysed using statistical tools (Creswell & Creswell, 2018, p. 17). This type of educational research often uses questionnaires, surveys and experiments to collect data around different variables. A survey design can provide a quantitative description of knowledge, attitudes and intentions to act of a population using a sample from that population (Creswell & Creswell, 2018, p. 147).

3.4.2 Qualitative research approach

It is a form of interpretive inquiry in which the researcher makes an interpretation of what is heard, seen, or understood to provide a holistic account of the issue using multiple perspectives (Creswell & Poth, 2016a, p. 39). The data collected in qualitative research are useful for exploring and understanding the meaning individuals ascribe to a certain human or social problem (Creswell & Creswell, 2018, p. 4). Data are collected from multiple sources and in the natural settings of the participants using methods like interviews, observations, and analysing documents. Data may be analysed using inductive and deductive processes and coded into

various themes which help in presenting the qualitative findings from different perspectives (Creswell & Creswell, 2018, p. 197).

Using both qualitative and quantitative research approaches, I chose a case study approach for my research as I wanted to understand the contemporary phenomenon of Food Waste Literacy in depth and within the real world context (Yin, 2014).

3.4.2.1 Case study approach

According to Creswell & Poth (2016a, p. 73), in case study research the researcher explores a case through detailed data collection, and reports the findings. Case studies look at a phenomenon in its real-life context and usually make use of many types of data (Cohen et al., 2018). They are descriptive and detailed with a narrow focus, and data are gathered rigorously and systematically. Case study data are strong on reality as they are in harmony with the reader's own experience, and provide insights into similar cases (Cohen et al., 2018). Case studies accept that there are many, multivalent realities operating in a situation, and the researcher's view and interpretation is only one of many (Cohen et al., 2018, p. 377). According to Gerring (2004), a case study is an intensive study of a single unit for the purpose of understanding a larger class of similar units. A unit implies a relatively bounded phenomenon (Gerring, 2004), which is the intervention study on the Food Waste Literacy of one class in my research. One of the strengths of case studies is that they can establish cause and effect as they observe 'how' and 'why' in real contexts (Cohen et al., 2018, p. 289). It was important to find out the ways in which food is wasted by the students and their understanding of the reasons for food waste. This finding was crucial to design the intervention for developing the students' Food Waste Literacy. Case studies may be prone to observer bias which may be addressed by reflexivity. I was conscious of being reflexive during my study and continuously questioning my assumptions and beliefs about food waste to reduce any personal influence on my study. Data were collected using multiple sources of information like observations, interviews etc. Stake (1995) has described different types of case studies. I chose to employ single instrumental case study (Stake, 1995) as I focussed on one issue of food waste and selected one bound case i.e., one classroom to illustrate this issue. According to Yin (2014), my research followed a descriptive case study path as I aimed at presenting a complete description of the Food Waste Literacy phenomenon (the case) in its real world context. Even

though students of Years 7 and 8 were initially planned for the research, for practical reasons, only Year 7 students were finally selected for the research. I decided to focus on intermediate aged students as research suggests that young children tend to gain positive attitudes towards the environment more easily than adults (Aguirre-Bielschowsky, Lawson, Stephenson, & Todd, 2017b; Eagles & Demare, 1999; Liefländer, Fröhlich, Bogner, & Schultz, 2013). Research also indicates that self-efficacy, the feeling that personal actions make a difference, mostly develops at young age (Hart & Nolan, 1999; Kahn & Kellert, 2002). Moreover, young adolescents are better able to consider abstract and complex relationships among topics and variables than are younger students because of their emerging cognitive abilities (Anderman, Sinatra, & Gray, 2012). The young adolescents are ready to entertain content knowledge about broader issues and they generally have the capability to reason and engage in creative problem solving as they are developing the reasoning, metacognitive and self-regulatory skills needed for problem solving (Anderman et al., 2012). The students in my study formed an accelerated class which means that they were being provided extra learning support and opportunities from their teachers, as compared to their counterparts in non-accelerated classes. There were an almost equal number of students of European and Māori origin, and also some international students in the class of varying ethnic backgrounds.

In the next section, I discuss the research methods and research design which I used to collect and analyse appropriate data, and address the research aim and questions, in my study.

3.5 Research methods

The different research methods used to collect data in this research were questionnaires, focus group interviews, interviews, document analysis, and observations. The methods used in this research are described individually in the next sub-sections.

3.5.1 Questionnaires

I chose to use a questionnaire as it is one of the widely used tools for collecting survey information and providing standardized and open responses on a range of topics (Cohen et al., 2018, p. 471). This is a very flexible tool which has the advantage of having a structure, being convenient for respondents, and being cheap, and quick to administer to a large number of

cases (Walliman, 2018, p. 110). There is no personal influence of the researcher during administration and there is a greater chance of getting an unbiased response (Walliman, 2018). However, the questionnaire may take more time to be developed, piloted, and refined (Cohen et al., 2018). It may also collect data which may be limited and superficial in scope because of the limited flexibility of responses. Respondents cannot be forced into completing a questionnaire which may affect the quality of data collected. The questionnaires can be structured or semi-structured depending on the aims of the research. There are many kinds of questions which can be included in the questionnaire, such as multiple-choice questions, open-ended questions, rating scale questions, and dichotomous questions.

I included four open-ended questions out of a total of 15 questions in my questionnaire. Open-ended questions are a good choice for smaller scale research as they provide for a personal comment from the respondents (Cohen et al., 2018, p. 476). However, they also pose a degree of difficulty for the researcher to aggregate the responses into similar themes and analyse the data. They are more demanding on the part of the respondents as answering them needs more time and effort as compared to close-ended questions. They can lead to incomplete, irrelevant, and redundant information. Notwithstanding, these questions provide a rich data source, which is unique to the individuals as there are no limitations of pre-set options.

I also included 11 closed questions in the questionnaire for my study. Closed questions have an advantage as they generate frequencies of responses which can be statistically analysed. They can be coded and analysed quickly. They are quick to complete and do not add pressure on the participants to write on their own. There is likely to be less of researcher and social desirability bias (Ruel, Wagner, & Gillespie, 2016). The questions can be asked in many ways like dichotomous questions which have a yes/no, agree/disagree or true/false response, multiple choice questions, rank ordering questions or rating scale questions.

Before the final questionnaire can be administered to the real sample, it is often administered to a small sub-sample from the same population. This pre-testing of the questionnaire helps to bring into notice any potential issues across the entire range of the questionnaire (Ruel et al., 2016). I pre-tested the questionnaire for this study, on ten students of another Year 7 class in

the same school. No issues were found in the questionnaire after analysing the responses of the sub-sample of the students.

3.5.2 Interviews

I used interviews in my study to collect data as they are flexible tools for data collection with their embedded multi-sensory channels of conveying sense through verbal and non-verbal ways. Interviews have been found to be more suitable for questions that needed probing to obtain deeper information (Walliman, 2018). The interview may have many purposes, but the essence is the transaction of information that takes place between the interviewer and the interviewee (Cohen et al., 2018). It might be used in conjunction with survey results to go deeper into the responses and the participants' reasons for those responses. As with other methods of data collection, interviews have their advantages and disadvantages (Doody & Noonan, 2013). The exploratory nature of interviews allows for a greater depth in the responses than other methods of data collection and a higher response rate. It permits the collection of rich data that answers questions about which little is known to the researcher (Nathan, Newman, & Lancaster, 2019). However, interviews can be biased and prone to subjectivity of the interviewer and the interviewee (Doody & Noonan, 2013). They take more time and may be inconvenient for responders (Cohen et al., 2018).

Interviews can be structured, semi-structured, and unstructured dependent on the research questions and the type of data to be generated (Doody & Noonan, 2013). The structured interviews have a pre-decided content and procedures. The sequence and wording of the questions are decided by a schedule and there is hardly any freedom for the interviewer to make any modifications, during the interview (Cohen et al., 2018). I used semi-structured interviews for collecting qualitative data with the students and the teacher because that involved having a set of guiding questions that kept the interview on track (Wilson, 2012). According to Cohen et al. (2018) semi-structured interviews have pre-decided topics and questions, but the questions are open ended. The wordings and the sequence can be altered with probes and prompts, according to each interviewee's response. The unstructured interview has the greatest flexibility and freedom for the interviewer but needs careful planning beforehand. There were many things which I had to plan and keep in mind like asking only essential questions, framing the questions appropriately, deciding on prompts, the use of probes and recording the interview

(Gillham, 2000). Whatever may be the format, the interview should have certain ‘quality criteria’ for example: - rich, specific, and spontaneous responses from the interviewee, does not require any additional explanations and descriptions, and enables continuous interpretation throughout the interview.

Similarly, a good interviewer must be attentive to the interviewees, be non-judgemental and use probes and prompts effectively. The interview questions for the teacher were carefully developed keeping in mind the teacher’s views and understanding about food waste, especially in the context of New Zealand and *The New Zealand Curriculum* (Ministry of Education, 2007). The effectiveness of the intervention in relation to the students’ and the teacher’s knowledge, attitudes and values, and behaviour about Food Waste Literacy was also considered while planning the interview questions. The interview was reviewed by myself and my supervisors to reduce any bias in questions, and for a thorough understanding of Food Waste Literacy of the teacher at the pre and the post-intervention stages.

3.5.3 Focus Group Interviews

A focus group is a specific type of group in terms of purpose, size and composition (Krueger, 2015, p. 2). A focus group usually has a small number of people, who possess common characteristics, and provides qualitative data. The focus group interview has predetermined and sequenced questions for a focussed discussion. The sequence of questions is the distinguishing feature of focus group interviewing. There are general questions before the specific questions and gradually the questions become more focused towards the inquiry. The questions should be clear, brief and unidimensional (Krueger, 1997) so that they can provide insights into the topic of discussion.

The strengths of focus groups include the insights that are revealed during the interaction with the participants (Morgan, 2018). These interactions provide a clarification on what the respondents think and why they think like that. The group dynamics become valuable for the researcher as participants are motivated to share their own thoughts after listening to experiences and outlooks, similar or different from themselves. However, focus group interviews can have a drawback of being researcher-centred, if all the conversation takes place

as a result of the researcher's initiative. They also sometimes lack the depth of individual interviews and generate less detailed information about individual participants. Despite these weaknesses, I used focus group interviews as it allowed me to gather valuable data by allowing a productive set of interactions among the students and thus learning from them (Morgan, 2019). These interviews are able to produce a large amount of data in a short period as there is synergy with many students stimulating discussion and motivating other students to contribute. Individual interviews with such young students may not provide insights which were possible in a group setting.

3.5.4 Document analysis

Document analysis is a means of providing information not seen or heard in observations and interviews (Court, 2018). I included document analysis as a means of data collection in this study because documents can provide important data, as what the students write or draw might be different from what they actually do or what they say (Court, 2018). Most documents in research settings usually exist as a natural part of the setting and help fill in part of the picture that the researcher wishes to understand. However, the researcher has to practice ongoing self-reflexivity to interpret the documents as the analysis can often be coloured by the researcher's values and assumptions (Court, 2018). Moreover, the documents themselves were not written with the intent that they would be analysed for this research so may not be entirely useful, relevant or complete.

3.5.5 Observations

The use of observation as a research method provides an opportunity to the researcher to gain first-hand live data from the participants which is more valid or authentic than data collected through mediated methods (Cohen et al., 2018, p. 542). Observation can be of facts, events, qualities, or behaviours. According to Cohen (2018), there is a continuum from the initial observation to the researcher's interpretation, evaluation of situations and a recording as a final observation. Observation can be structured or unstructured depending on the research purpose. A structured and systematic observation uses observation schedules or checklists which can provide numerical data to the researcher which can be used to produce frequencies of patterns or trends of the observation (McKechnie, 2008b). The researcher is passive and non-intrusive and may record the observations notes or a schedule. The preparation for such a schedule is

time consuming but the analysis is much faster (Cohen et al., 2018). In unstructured observation, the researcher undertakes the observation with some general idea of what might be salient without checklists. The researcher tries to document as much as possible about the participants and the settings in order to discover important themes and reports them in narrative style (McKechnie, 2008c).

The role of the observer in the observation can vary. In non-participant observation, the researchers may watch quietly from the side lines and record what they see (Court, 2018). There is no involvement with the participants, and it does not allow for any in-depth understanding of the research participants in their own world (Baker, 2006). As a complete observer, the researcher is present on the scene but does not interact or participate with the participants in any way and the role is limited to listening and observing (Baker, 2006). On the other hand, participant observation needs a balance of involvement by the researcher. The researcher needs empathy to gain access to a group to become an insider and observe insiders' behaviour and also needs to be detached from the scene of observation to record the observations (Cohen et al., 2018). I used the participant observation method to observe the students during the teaching-learning episodes of the intervention and used a classroom observation schedule prepared by me and my supervisors. I chose participant observation as I found it to be a useful tool in studying small groups, or for activities that lend themselves to being observed. Being a participant observer, I could access detailed information about what was happening in the classroom during the teaching-learning episodes. Participant observation allowed me to become one with the classroom situation and observe behaviour of the students and the teacher during the teaching-learning episodes (Kathleen & DeWalt, 2010). This provided opportunities to collect data by taking field notes of what was being seen, said, or heard in the classroom. Participant observation gave me the flexibility to use a mix of methods like direct observation of the participants, the physical features of the classroom settings, informal interviewing and document analysis (McKechnie, 2008a).

Observation is a particularly useful tool to gain insights into situations but like other research methods observation has its own issues of reliability and validity. There is a chance that the researcher will only see what they expect to see and could selectively report information instead of noting down all the observations (McLeod, 2015). To counter these, I employed other

methods of data gathering including questionnaire, interview, and worksheets, to corroborate and triangulate data collected from observation. In the next section I provide the details of the specific research design which I have used in this research.

3.6 Research Design

According to Creswell (2018, p. 11), a research design is a type of inquiry within qualitative, quantitative, and mixed method approaches that provides specific direction for procedures in a research study. It is a plan that is drawn up for organizing the research. Therefore, the purpose of the research decides the research methodology which in turn governs the research design (Cohen et al., 2018, p. 173). The research design was an intervention study with an evaluation, so pre-tests, an intervention and post-tests were designed. This section describes the research design of this research based on the aims, research questions and methodology chosen for this research.

3.6.1 Context of the study

This research was conducted in a Year 7 class of an intermediate school in New Zealand. It was aimed at exploring and developing the Food Waste Literacy of the students using a teaching-learning intervention. A pre-intervention questionnaire and focus group interview was designed for the students to explore their Food Waste Literacy. Thereafter, a Food Waste Literacy teaching-learning Unit was designed based on the pre-intervention findings and by using the guidelines of *The New Zealand Curriculum*. The Food Waste Literacy Unit had 14 teaching-learning episodes of 45 to 50 minutes each, designed by me with the approval of the class teacher and my supervisors. The design and planning of the Unit are explained in more detail in chapter 5. Following the intervention, its impact on the students was explored using the questionnaire and focus group interview. The effect of the intervention was also explored on the class teacher, by a post-intervention interview.

3.6.2 The population and sampling method

A population consists of all the objects or events of a certain type that share the same characteristics about which the researcher is seeking the information or knowledge (Allen, 2017). The population for this research comprised intermediate students in a New Zealand school. Since it was not possible to conduct research on such a large population, one

intermediate school was chosen for exploring a case in-depth as per case study methodology in my study. My chief supervisor suggested approaching an ‘Enviroschool’ as these schools integrate environmental education into every aspect of school life and are aimed at creating sustainable communities by empowering students through learning about sustainability (Enviroschools, 2020). My supervisor approached the regional co-ordinator of the selected region and asked about the feasibility of an Enviroschool in the area. The regional co-ordinator provided us the details of the school, which was subsequently approached by me, for carrying out this study.

3.6.3 The sample

A population may be broad or narrow in scope, but it is too difficult to collect data from each member of the population. Hence, I selected a subset of the population called a sample which was easily manageable for data collection and was representative of the population (Allen, 2017). The sample size for this research was dependent on many factors like:

- the research purpose, questions, and design. I had to select a sample class from the adolescent age group depending on the aim of my research.
- the nature and size of the population. It was not possible to involve a large number of students at the same time, hence a sample class was selected from an intermediate level school.

I used purposive sampling method for my research (also known as non-probability sampling) as the students of this class possessed the specific characteristics which I was interested in studying (Allen, 2017). Purposive sampling provided more in-depth information to me (Cohen et al., 2018). For my research, the intermediate school which was finally chosen was an Enviroschool and it offered me a lot of opportunity in terms of my sampling size. It had a total of 23 classrooms and 690 students. I provided information about my study and asked for informed consent from the principal of the school. The principal gave his consent and shared the information with the teachers to volunteer for this study. One class teacher volunteered for the participation of her class in the study, and both my supervisors drove down to this school to meet the class teacher and approve of the school settings. The students in this classroom were using Chrome-books. I was excited that I could use online platforms to support my intervention and students might have more engagement with the pathway already familiar to them. Unfortunately, that class teacher subsequently declined to participate in my study just

before I had to pilot test my questionnaire. Luckily, another teacher (Ms Lisa) (her pseudonym), volunteered for the participation of her classroom, and it was a Year 7 classroom with 30 students. This classroom was similar to the previous classroom as all the students had Chromebooks to support their learning. My research was aimed at exploring Food Waste Literacy of Years 7 and 8 students, but I decided to focus on Year 7 to carry out an in-depth study and have better insights into the detailed behaviour of only one class. All the students in the class were part of the intervention but the consent for the research was given by only 19 students. All the students took part in the pre-survey and post-survey, but the data were used from only the sample of consented students. The focus group interviews were carried out only with the consented students while data were also collected from the class teacher using interviews.

3.6.4 Data Collection

The data collection in this research was guided by the purpose of the research and the research questions. This section describes the process of data collection in this research using the various methods involved, such as questionnaire, focus group interviews, interviews, document analysis, and observation. Table 3.1 summarises the data collection methods used for the three research questions.

Table 3.1 Research questions and data collection methods

Research Questions	Research methods
What is the Food Waste Literacy of Year 7 students in a New Zealand school?	Questionnaire, focus group interviews, interview
What kind of pedagogical intervention might be designed and implemented to engage Years 7 students in developing Food Waste Literacy?	Questionnaire, focus group interviews, interview
How does a pedagogical intervention activate Years 7 students' inquiry and decision making about Food Waste Literacy?	Questionnaire, focus group interviews, interview, observations, document analysis

3.6.4.1 Questionnaire

The questionnaire was developed using a quasi-experimental design as it is useful in school settings where random assignment of participants may not be possible (Price, Jhangiani, & Chiang, 2015). The pre-test, post-test aspect of quasi-experimental design was applied as

similar data collection instruments (including questionnaire) were being administered before the intervention and after the intervention (McKinley et al., 2017).

The process of drafting the questionnaire started in the first week of December 2018 after a search of literature related to Food Literacy, food waste and Environmental Education to have a better understanding of the key concepts to be evaluated. The various aspects to be investigated were also referenced from other sources (Tilbury, 1995; Wals, 2011). Various revisions were made to the drafted questionnaire employing the BRUSO (Brief, Relevant, Unambiguous, Specific, Objective) criteria for effective questions (Peterson, 2000) under the guidance of my two supervisors. The wordings of questions and their order were redrafted repeatedly in accordance with best practices (Krosnick & Presser, 2009). The final version was then pilot tested with 10 students from another classroom of the same year level (Year 7) and in the same school on 10th April 2019. The students were given detailed oral instructions before they attempted the questionnaire. They were given half an hour to finish the questionnaire but most of them finished it within twenty to twenty-five minutes. The feedback from the pilot test did not suggest the need for any change in the sequence/wording of any question. The process for developing the questionnaire is shown in Figure 3.2



Figure 3.2 Process for developing the questionnaire

The questionnaire had 15 questions sub-divided into various categories of knowledge, attitudes and values, and behaviour towards food waste (see Appendix B). These categories were created taking a cue from the literature on environmental education which suggests that environmental literacy consists of four inter-related components: knowledge, dispositions, competencies and environmentally responsible behaviour (Hollweg et al., 2011). There were 11 close-ended questions in the questionnaire. The students were asked to choose their agreement to statements in these questions, with options ranging from agreeing a lot, agreeing, not sure to don't agree.

This 4-point scale was chosen as I was interested to know about the students' level of agreement with the statements. I did not include a 5-point scale with an additional middle or neutral response as I wanted the students to think deeply about their responses and not choose the middle option by default (Peterson, 2000). These options were relatively easy and quick for the students to complete and could be easily entered into an Excel spreadsheet by me. For the purpose of analysis, values were assigned for these options as 1, 2, 3, and 4, respectively. These categories and the specific questions can be seen below (see Table 3.2).

Table 3.2 Questions in the questionnaire

Components of FWL	Number of questions	Question numbers
knowledge	8	4, 6, 7, 8, 9, 10, 11, 13
attitudes/values	3	1, 2, 3
behaviour	4	5, 12, 14, 15

Knowledge of food waste

Eight questions evaluated the students' knowledge of food waste which aimed at probing the students' knowledge of harmful effects of food waste on the environment, places where food waste takes place (especially in New Zealand), reasons for food getting wasted, and the resources involved in the production of food. There was also a question about the wastage of resources associated with discarding various food items. Questions 4, 9, 10, 11 and 13 were closed ended questions where the students had to choose between four options. There were three open-ended questions (Q.6, Q.7 and Q.8) for which there were no options provided, and the students had to provide the answers based on their knowledge (at pre- and post-intervention stages). (See Appendix B).

Attitudes/values towards food waste

Three questions assessed the students' attitudes and values towards food waste, which helped in probing their attitudes/values towards leftover food, and overbuying of food, which is one of the causes of food waste.

Behaviour towards food waste

Four questions in the questionnaire explored the students' reported or intended behaviour towards food waste (at pre- and post-intervention stages). There were three close-ended

questions (Q.5, Q.12, and Q.14) and one open-ended question (Q.15). The open-ended question was included to probe more deeply the students' responses about ways to reduce food waste after the intervention was over.

The same questionnaire, as above, was used in the pre-testing and the post-testing on the actual sample in May 2019 and June 2019. Before the pre-test was administered, the students who had given their consent were allotted pseudonyms to be written on top of the questionnaire and on every activity sheet that was to be collected from them during the intervention. All the students present in the class were also given oral instructions by me with the help of the class teacher, about how to attempt and complete the questionnaire. The students were told to raise their hand if they needed any clarification whilst completing the questionnaire. All the students present in the class were asked to complete the questionnaire. They were given half an hour to attempt the questionnaire however, most of the students finished it within 25 minutes. The same process, as above, was followed for post-testing the students after the intervention was over.

3.6.4.2 Interviews

The class teacher was also a stakeholder in this research, and it was important to understand her knowledge, attitudes and values, and behaviour towards food waste and education for Food Waste Literacy at the pre- and post-intervention stages. The pre-intervention interview was carried out a day before the teaching-learning intervention. It lasted about seven minutes and was audio recorded to be transcribed and analysed. I prepared two interview schedules for the teacher, one pre-intervention interview schedule (see Appendix C) and the other post-intervention schedule (see Appendix D). The pre-intervention schedule had questions which predominantly probed the teacher's knowledge, attitude and values, and reported and intended behaviour towards food waste, which were similar to the categories in the student questionnaire. It also included questions about her views of the positioning of food waste in *The New Zealand Curriculum*. The post-intervention interview was carried out a week after the teaching-learning intervention was over and lasted about 9 minutes. The post-intervention schedule had questions which probed any changes in the class teacher's above-mentioned aspects of Food Waste Literacy, along with her observations about the development of the students' Food Waste Literacy in response to the intervention.

3.6.4.3 Focus Group Interviews

The Focus Group Interview was designed keeping the various components of Food Waste Literacy in mind. There were 11 questions in the Pre-Intervention Focus Group Interview (PFGI) probing the students' knowledge, attitudes and values, and reported and intended behaviour towards food waste (see Appendix E). The interview was carried out with one group of five students from the sample classroom. They were briefed about the guidelines of participating in a focus group, which included the use of pseudonyms during the conversation, and to respect each other's views. The interview lasted about ten minutes and was audio recorded, to be transcribed later. The Post-Intervention Focus Group Interview (PoFGI) had some questions different from the Pre-Intervention Focus Group Interview (see Appendix F). These additional questions were aimed at exploring - any change in the food waste behaviour of the students after the intervention, the students' most surprising learning about food waste, and knowledge about food waste that they would like to share with others. These interviews were carried out in four groups of four to five students each, including keeping the pre-intervention group intact for one PoFGI. The interviews lasted up to 15 minutes and were audio recorded for transcription and analysis.

3.6.4.4 Observations

An observation schedule (see Appendix G) was prepared for all the teaching-learning episodes. This was developed using a template provided by my supervisor. The schedule was aimed at observing and recording the students' in-class behaviour that would indicate their engagement with the class activities. I prepared the schedule to observe the engaged students' listening, responses, and behaviour, and to record my personal reflection about each teaching-learning episode, which usually lasted 45 to 55 minutes. The observation schedule also had space about my personal reflection about the task, any anecdotal recording, and comments for future effectiveness of the episode. Since it was participant observation, I also took field notes along with putting down important details briefly in the observation schedule. I completed the observation schedule immediately after the completion of each teaching-learning episode.

3.6.4.5 Document Analysis

Eleven classroom activity sheets were designed based on individual teaching-learning episodes. These sheets were developed by me and verified by the teacher as appropriate for the

students. These sheets were completed by all the students in the class and collected by me at the completion of each class. Only those sheets from students from whom I had informed consent were subsequently used as data. The details of the participants' documents were kept confidential in the research findings by the use of allotted pseudonyms (Lambert, 2019). In the next section, I present the procedures which I used for the analysis of the data collected in this research.

3.7 Data analysis

A mixed method approach was followed for this research. The details of the different qualitative and quantitative methods employed to analyse data are provided in the next sub-section.

3.7.1 Quantitative data analysis

Data analysis started with separating the close-ended question responses in the questionnaire and marking down the frequencies of the various response options in a Microsoft Excel spreadsheet, which were assigned values from one to four. Microsoft Excel functions were used to generate the group means and standard deviation of each sub-question. The calculation was carried out for the responses in the pre-test and the post-test questionnaire. These descriptive statistics were used to indicate the patterns of the students' responses at the pre- and the post-intervention points about the students' knowledge, attitudes and values, and reported and intended behaviour towards food waste. The results of the pre-test and the post-test were compared using tables to explore any differences in the students' responses after the intervention. The sample size of 19 was a limitation, as only 19 out of 30 students had given their informed consent for the research participation. This small sample size may affect the sample mean and may tend to have larger standard deviation. The quantitative data analysis process is explained by Figure 3.3

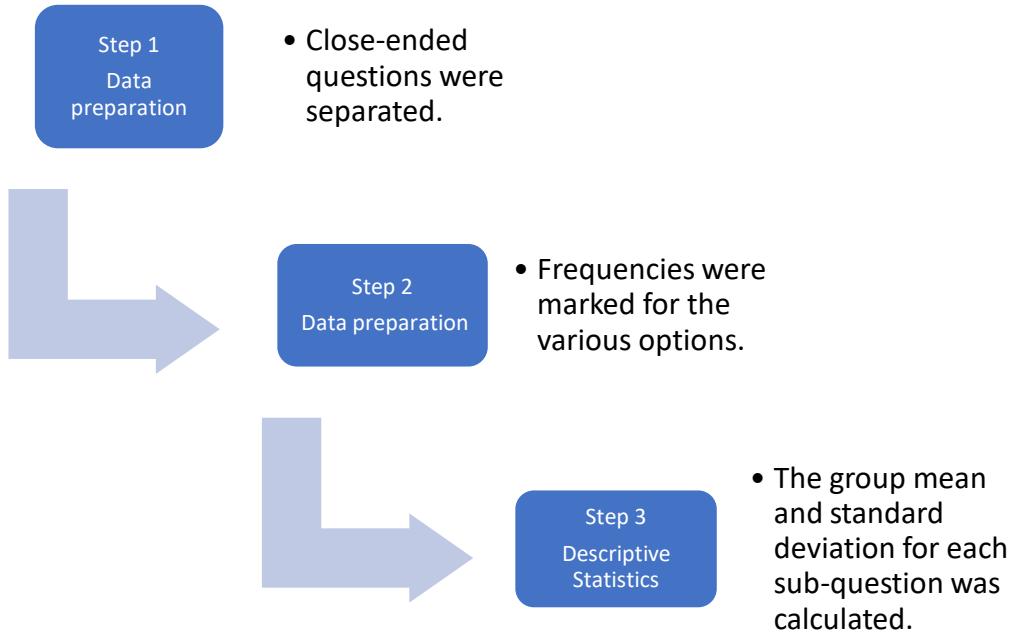


Figure 3.3 Quantitative data analysis process

3.7.2 Qualitative data analysis

Qualitative data are analysed step by step to make sense out of the data by segmenting and taking apart the data as well as putting it back together (Creswell & Creswell, 2018, p. 119). I made use of thematic analysis for analysing the qualitative data in this study (open-ended questions in the questionnaire, focus group interviews, and interviews). This is a method widely used for identifying, analysing, and interpreting patterns of themes or meanings within qualitative data (Clarke & Braun, 2017). Using thematic analysis, large or small qualitative data sets from interviews and focus groups or any other widely used qualitative techniques can be analysed (Braun & Clarke, 2013). The data analysis outcome using the thematic analysis was initially facilitated using the qualitative data analysis software NVivo. It is software which allows to analyse text documents such as interviews and open-ended survey responses to understand key concepts, patterns and perceptions (QSR, 2018). Figure 3.4 illustrates the steps that were followed to analyse data in this research.

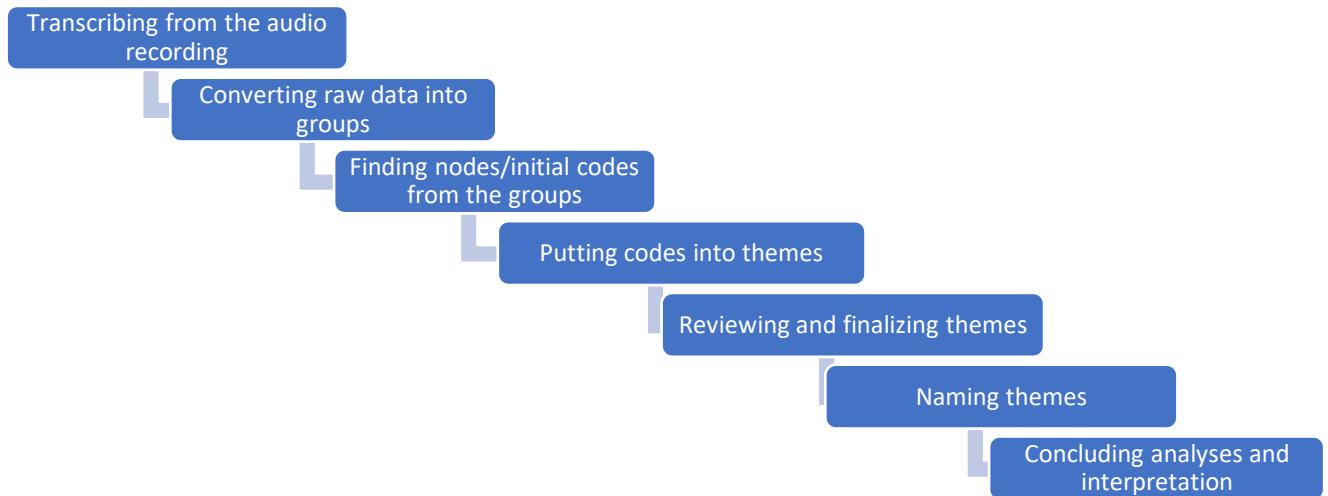


Figure 3.4 Process of qualitative thematic analysis

I followed thematic analysis (Clarke & Braun, 2014), which offers a six-phase process, to analyse focus group interviews, questionnaire and interviews and the steps were as follows: -

1. Familiarisation with the data: This phase involves transcribing data and reading it multiple times to note down initial ideas. Accordingly, the audio recordings were transcribed and rechecked for accuracy. The transcript was read and re-read, and notes were taken about the initial observations from the recordings. The transcripts for the interviews were sent to the class teacher for checking.
2. Generating initial codes: This phase involves identifying and sifting labels or codes that identify important features of the data which might answer the research questions. The entire dataset is coded and collated for later analysis. Therefore, for this study, the transcripts were formatted and loaded onto NVIVO for capturing the initial codes. These codes were collated by putting all the data relevant to each code together. These codes were themes like environment, greenhouse, landfill, compost, resources and reduce that were found across the students' responses in the transcribed data.
3. Searching for themes: In this phase, codes and collated data are identified for important broader patterns of meaning (themes). Each theme is then collated with relevant data. Hence, guided by my research questions, I put all these into groups to create a set of potential themes.

4. Reviewing themes: In this phase themes are checked against the dataset to see if they are answering the research questions. Accordingly, I merged these groups into themes, reviewed, and analysed until I was convinced that the individual themes were coherent and that they had captured the most relevant features of the data.
5. Defining and naming themes: In this phase each theme is analysed in detail for the overall story the analysis tells and names for each theme are generated. Thus, the themes were interpreted, analysed, defined, and named under various concepts of Food Waste Literacy.
6. Producing the report: This phase involves weaving together the analytic narrative and data extracts and producing a scholarly report of the analysis. I wrote the final themes and further analysed them in the context of the research questions.

The document analysis of the classroom activity sheets was carried out to review and interpret the data so that I could supplement that to triangulate findings which I had gathered from Post-intervention Focus Group Interviews (PoFGI) and class observations. I had to interpret each activity sheet separately, as they were individually created for the different teaching-learning episodes. The interpretations were integrated with the other findings and converged with themes which had evolved from focus group interviews and the questionnaire.

3.8 Enhancing the quality of the research

The quality of research is evaluated by considering its validity, reliability and trustworthiness (Noble & Smith, 2015). Validity is a demonstration that a particular instrument in fact measures what it intends, purports or claims to measure (Cohen et al., 2018, p. 245). In quantitative research, validity usually strives to achieve- controllability, replicability, consistency, predictability, sample randomization, objectivity and observability (Creswell & Creswell, 2018). Whereas the key criteria of validity in qualitative research (Lincoln & Guba, 1985) are - credibility, transferability, and confirmability. Validity in mixed methods research, as in this research, had to conform to the specific requirements of both the quantitative and the qualitative research validities (Cohen et al., 2018). There is a need of sample integration if there are different samples for qualitative and quantitative research components. The inferences from both the research datasets have to be legitimate to ensure validity, reliability, and trustworthiness. To ensure validity in this research, the following steps were undertaken-

- a. the students were chosen from an intermediate level school. They were given the option of participating/not participating in the research. They also had the choice of opting out of the research at any time during the research. All the students were provided the information sheet and the consent forms before the research started. They were informed that their answers in the questionnaire would not affect them in any way as no-one would see their specific responses except me, and data would be reported in an aggregated manner.
- b. multiple data sources like questionnaire, focus group interviews and class observations were used for the purpose of triangulation. Triangulation refers to the use of multiple sources of data to enhance the credibility of a study. I employed data triangulation by using multiple sources of data to align multiple perspectives leading to a more comprehensive understanding of Food Waste Literacy of the students.
- c. member checking of the transcripts was done by sending the transcripts to the class teacher for checking the accuracy of the transcripts.
- d. reflexivity was kept in mind by me, and analysis was done accordingly. I am an Indian teacher researching in New Zealand. I have been trained in an education system different to that in New Zealand. I have a belief in the importance of education as a powerful tool to promote behavioural changes. I have a strong interest in food waste and want to contribute towards food waste reduction. I was always conscious of my assumptions and pre-conceived ideas during my study. I was constantly making an effort to situate myself socially, emotionally, and intellectually in relation to the students and the teacher in my study.
- e. a rich and detailed description of the settings was provided which enabled a shared experience and provided a realistic experience of the settings.

In this research, mixed methods approach was used for case study which specifically focusses on three main types of validity- construct, internal and external. Construct validity was addressed by using multiple sources of evidence. Internal validity was addressed by having a robust research design to conduct a well-researched study and using triangulation. As this research was a case study which are context-specific and are subjective, there was limited external validity and the findings are only transferable to other contexts by the reader.

Reliability in research essentially consists of dependability, consistency, and replicability over time, over respondents and over instruments (Cohen et al., 2018). To ensure reliability in this case study (Zohrabi, 2013), the following steps were taken:

- a) detailed description of data collection, data analysis, and arriving at the results.
- b) all the documentary evidence which was collected using different tools like - questionnaire, focus group interviews and class observations, were kept safely.
- c) varied types of information were collected through different tools.
- d) all aspects and stages of the research were documented for checking for transparency.
- e) the data collection setup was kept same for all the participants as they were given the same information, instructions and were tested under the same conditions.

Trustworthiness is another dimension of the quality of mixed methods research and the best known criteria of trustworthiness are credibility, transferability, dependability, and confirmability (Korstjens & Moser, 2018; Lincoln & Guba, 1986). The credibility criterion is the confidence that can be put in the truth of the research findings. I enhanced this by data triangulation and classroom observations. The transferability criterion is the degree to which the results can be transferred to another setting. I enhanced this by providing a thick description of my research settings (context), the participants, and the research design. The dependability criterion considers the degree to which the research findings could be confirmed by other researchers (Korstjens & Moser, 2018). This was enhanced by me by using only the data generated in the study. The confirmability criterion establishes the level of confidence that the findings are supported by the data (Schultz & DeCuir-Gunby, 2017). Confirmability in this research was enhanced by being conscious of my personal biases which may influence the research findings, meticulous data recording and including thick and verbatim descriptions of the participants' accounts to support findings (Noble & Smith, 2015).

In the next sub-section, I will indicate the ethical considerations involved in this research as transparency and integrity are essential in any research.

3.9 Ethical considerations

Ethical considerations deal with what is good and bad or right and wrong for the research process. Ethical decisions are contextually situated (Cohen et al., 2018), and each research undertaking is a unique event. Ethical codes of practices are created to:

- a. protect the interests of individuals and institutions.
- b. ensure suitable informed consent of all the participants involved. The school principal, class teacher, students and the parents/guardians were provided with the information sheet and the consent sheet to ensure informed consent in this research.
- c. ensure that the proposed research abides by legal requirements and does not violate ethical principles. I ensured that all the instructions given by my supervisors about the ethics of carrying out this research were always kept in mind by me.
- d. ensure that data will only be used in the way, which is intended for the research. All the data collected for the research work has been kept safely and used only for the research purpose.

Many institutions of higher education have their own human research ethics committee with their own codes of ethics against which each research proposal is evaluated (Cohen et al., 2018). My research followed the ethics protocol and guidelines of the Technology, Environmental, Mathematics and Science (TEMS) Education Research Centre at the University of Waikato. The University of Waikato Human Research Ethics Committee approved my research proposal (see Appendix A) and the information and the consent forms for this research.

The informed consent in the process of ethics development concerns autonomy and it arises from the participant's right to freedom and self-determination. Under self-determination, the participant has the right to refuse to participate or to withdraw from the research activities (Cohen et al., 2018). All the four components of the informed consent competence, voluntarism, full information, and comprehension were carefully considered while the consent was being prepared and gathered. Competence, which conveys that the individuals are responsible enough to make an informed decision about participating in the research was gained through the consent forms. Those forms were duly read and signed by the students and their parent/guardian/whānau (family) (for students living with their caregivers). Voluntarism, which encompasses ensuring that the participants freely choose on their own to participate or

not to participate in the research, was also considered. The consent forms for this research included the consent of the students along with their parents/guardians. The other two components, full information, which means that the participants give consent and are fully informed about the research, and comprehension, which implies that the participants completely understand the research project and its procedures were also considered during the consent process. The information sheet and the consent sheet were read and explained in detail to the students in the class by me. The students were invited to ask for any clarification regarding the consent sheet and the information sheet about participating in the research. I was also conscious of the other facets of ethical research, such as privacy, anonymity, and confidentiality which are essential for any successful research work.

The information and the consent sheet were prepared keeping all the vital aspects of the ethics of research in mind. Access was gained into the school after the initial identification of the school as a possible research site and guidance by the research supervisors. The school principal was approached with a detailed information letter (see Appendix H) about the research and a request to undertake the study in the school, and for guidance for an appropriate class of participants. The school principal gave his consent for the research and subsequently, one class teacher volunteered for her students to be involved in the research. However, that class teacher pulled out from the research participation before the actual research work started. Another class teacher then volunteered for her students and herself to be involved in the research. The class teacher was given the information letter and the consent sheet for her approval for the research (see Appendix I). Thereafter, the students were provided with the detailed information letter and a consent sheet for themselves/their parents, whānau, guardians (see Appendix J). I gave the participants my, and my chief supervisor's, contact details (email id and phone number) for any details about the research, and if there were any concerns during the research. The students were asked to get the form signed by their parents, whānau or guardians and also sign themselves if they wished to participate. It was explained to them that the answers provided in the questionnaire and focus group interviews would be kept confidential by me and my supervisors. I was careful not to share any specific student's data with the teacher unless she had legitimate access to the student work.

3.10 Chapter Summary

In this chapter I have presented the research methodology and different methods used in this study. The chapter started with restating the aims of the research, followed by outlining the three research questions. The different paradigms in the research education were discussed to explain my choice of the interpretivist paradigm for this research, as all the students had their own and unique reality of food waste. Under this paradigm, Food Waste Literacy of the students was explored based on their socio-cultural backgrounds and experiences. Thereafter, the various research approaches were presented and the use of mixed methods research, as selected by me in this interpretivist approach, was justified. The use of a case study approach for this research was discussed subsequently. The next section presented the research methods used in this research: - questionnaire, focus group interviews with students, individual interview with teacher, observation, and document analysis. I followed this by addressing the research design, where the details of the context of the research, population and sampling method, sample size, and data collection process were described. The data analysis approaches used in this research were discussed, including the qualitative and the quantitative analysis. This included using NVivo, Excel, and content analysis for data coding and analysis. This section was followed by the validity, reliability, and trustworthiness of the instruments. Validity was enhanced by giving option to the students to participate/not participate in the study, providing information sheet and consent form to them, using multiple sources of data collection for triangulation and being reflexive throughout my study. data collection process, and data analysis. I enhanced reliability in my study by carefully using the tools for data collection and keeping identical set-ups for all the students by giving them the same information, instructions and test conditions. I enhanced trustworthiness in my study by ensuring credibility, transferability, dependability and confirmability criteria. In the end, the ethical considerations for the research and how they were considered and executed for this research, were presented. Ethical considerations were vital to maintain transparency and integrity in my study. I got an approval for my study from the University of Waikato Human Research Ethics Committee and then prepared information sheets and consent sheets for the participants. I contacted the school that was selected by me and my supervisors after these sheets were approved by my supervisors. Once the school principal and the class teacher had given their consents, the information sheets and consent sheets were given to the students.

The next chapter presents the first findings chapter which answered the first research question about the current status of Food Waste Literacy of the sample of students.

Chapter 4 – Pre-Food Waste Literacy Intervention Findings

4.1 Overview of the chapter

This is the first of the three chapters on findings. In this chapter, I present the findings of the first research question about the exploration of the Food Waste Literacy (FWL) of Year 7 students of New Zealand. The students' data had been collected using a questionnaire and a focus group interview. Data from the class teacher, about her Food Waste Literacy, was collected through an interview. In section 4.2.1, I report the findings about the students' knowledge about food waste and the teacher's knowledge about food waste. It is followed by section 4.3 that describes the students' attitudes and values about food waste along with the teacher's attitudes and values. Section 4.4 presents the findings about the reported behaviour of the students towards food waste, followed by the teacher's reported behaviour towards food waste. A summary of the chapter forms the last section.

4.2 Food Waste Literacy of the students and the teacher

The level of Food Waste Literacy (FWL) of the students prior to the intervention was evaluated by administering a questionnaire which focused on aspects of their knowledge, attitudes and values, and behaviour towards food waste. Some of these students also participated in a focus group interview to further explore the students' level of Food Waste Literacy. The class teacher was also interviewed to probe her knowledge, attitudes and values, and behaviour towards food waste.

4.2.1 Students' knowledge about food waste

Knowledge about food waste forms an important component of Food Waste Literacy. Therefore, the questionnaire had questions which probed the students' knowledge about food waste. There were 15 questions in the questionnaire (refer to Appendix B). The eight questions about the knowledge component were questions 4, 6, 7, 8, 9, 10, 11 and 13. In the questionnaire the students were asked to rate their agreement to statements in these questions, with options ranging from agreeing a lot, agreeing, not sure, don't agree. For the purpose of analysis, values assigned for these options were 1, 2, 3 and 4, respectively. Data about the knowledge component were also obtained from the Pre-intervention Focus Group Interview (PFGI) and these are reported here.

All 19 student participants gave responses for the questions about the knowledge component of the Food Waste Literacy. Through Questions 4 and 9 the students were asked about their awareness of the consequences of food waste on the environment which is a vital component of Food Waste Literacy. The data for these two questions are shown in Table 4.1 which presents the number of responses, the means, the medians and the standard deviations for the two items.

Table 4.1 Students' awareness of the consequences of food waste on the environment (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
When people throw away food, it causes environmental problems. (Q.4)	2	7	9	1	2.47	3	0.77
Food that is thrown away produces gas which is harmful to the environment. (Q.9)	3	2	12	2	2.68	3	0.89

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

Just over half of the students (9/19) were not sure that the wasted food causes environmental problems. A further nine students who had varying degrees of agreement about the connection between food waste and its environmental impact. Similarly, a majority of the students (12/19) were unsure about the production of harmful gas from the wasted food. However, there were five students who agreed to this aspect of wasted food. Similar findings were obtained from the students in their responses in the Pre-intervention Focus Group Interview (PFGI). For example, in response to the question, "Do you think wasting food is a problem?" (Q. 8 PFGI), the students talked about the frequency and quantity of the wasted food. One of them said, "Some people throw away like huge heaps of [food]" In response to another question, "Why do you think it is important to think and talk about food waste?" (Q.10 PFGI), all the students appeared to agree that food waste was not a good thing. One of the students commented, "because then we can kind of think about it and we know that it's a bad thing, so we try to

prevent it from happening.” However, they did not use any words which seemed to convey that they knew the connection between food waste and the environment. They did not speak about any impact of food waste on the environment.

The next set of questions were aimed at probing the students’ knowledge about ‘where’ and ‘why’ of food waste. These were questions 10 and 11 in the questionnaire. These questions were about the places where food waste takes place that may have been familiar to the students and the common reasons for food getting wasted (see Table 4.2).

Table 4.2 Students’ awareness about common places and reasons for food waste

	Agree a lot	Agree	Not sure	Don’t agree	Mean	Median	Std. Dev.
I think food could be wasted in New Zealand in these places (n=19):	2	1	11	5	3	3	0.88
a) on farms							
b) when it is being transported from place to place	0	7	8	4	2.84	3	0.76
c) In supermarkets	2	5	7	5	2.79	3	0.98
d) In homes, marae, restaurants and hotels	2	9	6	2	2.42	2	0.84
I think, people waste food when they (n=18):	4	9	4	1	2.11	2	0.83
a) buy too much food							
b) don’t eat leftovers	7	7	3	1	1.83	2	0.86
c) store food poorly	3	9	6	0	2.17	2	0.71
d) don’t understand food labels	0	3	14	1	2.89	3	0.47
e) cook too much food	1	9	5	3	2.56	2	0.86

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don’t agree = 4

Responses to these two questions showed that there was a varying level of uncertainty amongst the students about the places where food waste takes place across New Zealand. The number of students who were ‘not sure’ about food waste happening on farms was the highest at 11 while there were five students who did not agree with this statement. There were eight students who were ‘not sure’ and another four students who ‘did not agree’ about food waste taking place during its transportation. Six students were ‘not sure’ about food being wasted at homes, marae and hotels. There were 16 students who were not sure or did not agree to food being wasted on farms, while 12 students were not sure or did not agree to food being wasted in transportation and in supermarkets. The knowledge that food waste occurs in places like farms,

supermarkets and during transportation is maybe unfamiliar, not experienced, or not encountered by the students.

In response to the question about varied reasons for people wasting food, four students were not sure about food getting wasted because of people overbuying food. One student did not agree with this option at all. Three students were not sure of food getting wasted by people not eating leftovers. There were six students who were unsure about food getting wasted by poor storage. There were 14 students who responded that they were not sure about food being wasted because people don't understand food labels properly. These students could be unaware of the presence of food labels and their interpretation on the food packets. Moreover, eight students did not agree, or they were not sure about food being wasted because of cooking too much food. This could be due to the non-involvement of the students in the preparation of food at homes.

A limited level of knowledge about food waste was also seen in the Pre-intervention Focus Group (PFGI) responses. The students' responses to the question, "Can you think of some places where food is wasted?" were limited to "maybe in like restaurants," "in homes," "in the bins" and at "fast food places." The students' responses to the question, "Why do some people waste food?" were "maybe because they [people] fall for that moment and they can't be bothered about eating it [food]" and "they prefer just not to eat and waste it [food]." There seemed to be no awareness of any other reason for food getting wasted.

Next I present the findings about the students' knowledge about the food item which causes the maximum amount of waste of the resources which are used in producing various food items. This knowledge component of Food Waste Literacy was probed through the question, "We waste the most energy when we throw away which of these foods?" (See Question 13 in Appendix B). The students' responses were a mix of all the choices provided in the answer indicating that the students had no clarity about the food choice commonly recognised as being energy intensive (see Table 4.3).

Table 4.3 Students' awareness about waste of energy associated with food waste (n=18)

Food item	No. of students
bread	3
egg	6
beef	4
banana	5

Only four students chose the expected response, which was beef. According to the World Wildlife Fund (WWF) (2019b) “it takes about 25 times more energy to produce a calorie of beef than to produce one calorie of corn for people to eat. Animal proteins tend to require more energy and land and water to produce than plant proteins.” Students seemed to be unaware that a varying number of resources are needed to produce various kinds of food and that the meat production utilizes a high level of resources. This level of knowledge was further supported by a question in the Pre-intervention Focus Group Interview. The students were asked “What kinds of food do people waste?” Most of the students said “bananas” and “fruit and vegetables” which may reflect their subjective experiences at home, as meat may not be usually wasted in their homes. That may be the reason the students did not select ‘beef’ as the featured wasted food item being associated with the waste of the most energy resources.

To further understand the students' knowledge about food waste, there were three open-ended questions in the questionnaire. These questions provided an opportunity to the students to express their thoughts without any prompts. The students' responses were analysed, and certain common responses emerged from them. One of the themes that emerged from the students' common responses was ***environment***. This theme was arrived at in relation to the question, ‘In what sorts of places does food gets thrown away’ (see Question 6 in Appendix B). There were 17 students out of the 19 students who mentioned the natural environment like seaside, parks, for disposing off food waste. The students' answers were limited in places where people dispose of food waste. The students did not seem to know about various other places where food is wasted such as on farms, hotels, restaurants etc.

Another theme that emerged from the set of common responses that could be identified was ***food waste disposal systems***. The students' responses were varied for the question, “Where does unused food finally end up?” They responded that unused food ended up in various places in our environment like in “rubbish bins,” “in sea,” “in ground” and “in compost.” Only one

student mentioned that unused food ends up in landfills. This indicated that the students were not aware that all the wasted food, which is put in rubbish bins, finally ends up in a landfill.

Knowledge of resources required in food production was another theme that emerged from the set of common responses of the students to the open-ended question, ‘What resources are used for producing food?’ The students had written many man-made and natural resources which are used in the production of food. The students’ responses included “containers,” “electricity,” “fertilizer,” “chemicals” and also “farms,” “water,” “sunlight,” and “soil.” However, there were no responses about other important resources including money and human effort which are also wasted when food is wasted. There was only one student in the Pre-intervention Focus Group Interview (PFGI) who said, “I feel sad about it [food] because you work so hard for that money, and you are going to buy something [food] that will never be used.”

The analysis of the students’ responses which had helped in exploring their knowledge about Food Waste Literacy, helped in identifying some key ideas for planning the components of the intervention. Some of these ideas which could be included in the intervention were: - the impact of food waste on the environment, places where food is usually wasted, common reasons for food getting wasted, resources used in the production of food and the end point in the food waste journey.

4.2.2 Teacher’s knowledge about food waste

The class teacher was also interviewed (see Appendix C) to find out about her knowledge of food waste, as she was another stakeholder in the class intervention besides the students. It was particularly important to explore her knowledge about food waste before planning an intervention. I considered it was crucial to become aware of the teacher’s awareness on the issue of food waste as her level of Food Waste Literacy would also impact her students’ Food Waste Literacy. Therefore, in the interview I asked her asked about her views about food waste. She said “... you know there’s a general lack of education... there’s a general lack of highlighting from the government as well, you know in places like in Japan they have a program that looks to diminish food wastage but in New Zealand you don’t really see that.”

The teacher seemed to be aware of food waste awareness programmes in other countries and lack of such initiatives in New Zealand. The teacher was also asked if she saw food waste as a big problem in New Zealand. She said, “I don’t think it’s like a big, big problem. I mean there are other things that are way worse. But it is a problem, and it is something that should be introduced for the citizens of New Zealand.” The teacher did not see food waste as a big problem in New Zealand, but she definitely thought of it as a problem which needed consideration. I explored the teacher’s awareness about food rescue or food waste reduction work and asked her if she had seen anything happening in New Zealand about food waste. The teacher responded that she had not seen much happening about food waste in New Zealand. She said, “there’s those kinds of things but those are more like private businesses that are incorporating... it’s not like a national movement.” However, the teacher had agreed to facilitate my study in her class as she cared about the environment. She was keen on this research and wanted her students to develop their Food Waste Literacy. She said that she always reminded her students not to waste food as she herself believed in not wasting food.

4.2.3 Students’ attitudes and values about food waste.

Attitudes and values about food waste make an important component of Food Waste Literacy as our attitudes and values influence our thoughts, words, and actions towards food waste. Therefore, the questionnaire had three questions to specifically probe students’ attitudes and values towards food waste. These were questions 1, 2 and 3 in the questionnaire. Data about the attitudes and values component of food waste was also obtained from Pre-intervention Focus Group Interviews (PFGI) and these are also reported here.

I first discuss the students’ attitudes and values towards leftover food which has been found to be commonplace for food getting wasted. This question was important as the students had to think and decide amongst the various options, based on their attitudes and values towards leftover food. Question 1 in the questionnaire asked the students about what they would like to do with leftover food on celebration/special occasions with family/whanau at home (See Table 4.4).

Table 4.4 Students' attitudes and values about leftover food (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
If my family/whanau had a celebration I would like to-							
a) share any leftover food with the guests	2	9	6	2	2.42	2	0.84
b) pack any leftover food in the fridge to eat the next day	9	9	1	0	1.58	2	0.61
c) throw the food in the rubbish bin	0	1	4	14	3.68	4	0.58

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

There were 11 students who agreed to sharing leftover food. This could probably mean that those students were at least thinking about or had attitudes and values in relation to sharing leftover food. Six students were not sure, and two students did not agree about sharing leftover food with the guests. These six students were on the threshold of agreeing and did not agree about sharing leftover food. This meant that with the right kind of intervention, their values towards not sharing leftover food might be changed positively towards agreement for sharing leftover food. It is possible that the two students who did not agree at all about sharing leftover food had no experience of sharing food, as attitudes and values are often formed on experiences and surroundings in life.

There were 18 students who agreed to keeping leftover food in the fridge. This could mean that these students had experienced this happening in their homes and surroundings and had developed the attitudes and value of storing leftover food. Only one student was not sure about packing away leftover food, and this could be interpreted that the student may not have seen this happening at his/her home.

Four students were not sure about throwing leftover food in the rubbish bin and one student agreed with the idea of throwing leftover food in the rubbish bin. These four students may have these attitudes and values towards leftover food because they may have seen it happening in their surroundings or they have never thought about it earlier. These students were on the

borderline between saving and discarding food and an intervention might have helped them to change their attitudes and values positively towards leftover food. The only student who had agreed to throw leftover food in the rubbish bin might have seen such events in his/her surroundings and he/she might have accepted it as an acceptable behaviour. However, 14 students did not agree with throwing leftover food in the rubbish bin.

The students' attitudes and values about wasting food in general, are the next focus in my findings. In the Pre-intervention Focus Group Intervention (PFGI), the students were asked, "do you ever throw away food at home?" The students' responses to the question included:

- "Yes, I do."
- "Yes sometimes."
- "Yes, my dinner, but since I live on a farm I just chuck it [food] outside for the animals to eat or if I can't finish anything I put it in my mom's or dad's plate."

The students responded that they do throw away food at home and a few students shared that they gave their food to their pets. I had supplemented this question with another question in the Pre-intervention Focus Group, which would further help me to probe the students' attitudes and values towards wasting food. The students were asked the question, "How do you feel about throwing away food at home?," and some of the students' responses were: -

- "I kind of feel a little guilty after doing it [throwing food] but okay while doing it."
- "Sometimes I don't care because it [food] is given to the dog and he eats it. And sometimes I feel bad 'cos I waste it [food] so much."
- "Yeah I feel bad most of the time."
- "If I can't finish it [food] I would save it for later to eat."
- "I don't feel too bad."
- "Like if I am too full I would leave it for the next day."
- "I know if I chuck it [food] to the animals, then it just goes to something that's living and it doesn't like to go into the ground."
- "I don't feel any guilt because if my mum and dad can't finish it [food] then my dog can easily finish it..."

There was a mixed response from the students. Some of the students did not feel bad as they felt their other family member or pet was able to eat the food wasted by them. However, some of the students did mention that they felt bad about wasting food.

The students' attitudes and values about other people's choices leading to food waste, was explored next. The questions were intended not to know about the individual student's decision but about people's choices. I considered including these 2 questions (Questions 2 and 3 in the questionnaire) because asking these questions in an indirect way, might provide an inside view of the true attitudes and values of the students about wasting food. They were about food given to people which they don't want to eat, and people buying too much food for themselves (see Table 4.5). These two questions probed students' attitudes and values about two different aspects towards food which gets wasted as an end product.

Table 4.5 Students' values about food which people don't want to eat, and values about overbuying of food by the people (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
If people are given food which they don't want to eat, I don't think they have to eat it. (Q.2)	4	7	6	2	2.32	2	0.95
I think that people buy too much food for themselves. (Q.3)	1	6	9	3	2.74	3	0.81

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

Six students were not sure, and two others did not agree to the question that people don't have to eat food given to them which they don't want to eat. These eight students may have felt that food should not be wasted even if they don't want to eat it. This question was like a dilemma for the students' values about food being wasted. The students had to think about their values about discarding food while answering this question. However, 11 students agreed to varying degrees to this question. For these 11 students, people not eating food given to them which they don't want to eat, seemed acceptable.

Seven students agreed to the question that people buy too much food for themselves. These seven students could have had some experience of buying food on their own or with their family, and they could relate to the concept of overbuying. However, there were nine students who were not sure and three students who did not agree to this aspect. These students may not have experienced overbuying of food and hence were not able to visualise it. This lack of experience of being involved in buying food, might have acted as a barrier for these students to engage fully in the Food Waste Literacy.

After analysing the responses to explore the students' attitudes and values about food waste, some key ideas emerged for planning the components of an intervention. Some of the ideas which could be included in the intervention were: the concept of storing and donating leftover food, preparing a food budget and awareness about the prices of the day-to-day food items.

4.2.4 Teacher's attitudes and values about food waste

The class teacher was also interviewed to find out about her attitudes and values towards food waste (see Appendix C). The teacher seemed to support the idea of developing her students' Food Waste Literacy and that is why she had agreed to help in my study. On being asked, "do you think teachers have any responsibility for engaging students to learn about food waste and why?," she said, "I am quite passionate about my students wasting [sic] food and they [students] know it because I growl at them if they waste food." This showed that she valued food not getting wasted and had been taking steps towards avoiding food waste in the class. In response to the question, "do you think teachers have any responsibility for engaging students to learn about food wastage and why?" she said, "yes, yes. They [teachers] do. I mean we [teachers] are trying to get our students ready to be good New Zealand citizens and in order to do that we have to be mindful about the wastage we produce." She valued that, teachers need to promote awareness in students about food waste, as a part of being good citizens of New Zealand. In response to the question, "do you think the students as future decision makers and citizens of New Zealand have a responsibility towards food waste?," she said "of course. We [students] need to protect our country Kaitiakitanga [guardianship and protection, according to the Māori world view]." This statement indicated that the teacher wanted the students to have positive attitudes and values towards food not being wasted, by keeping in mind the Māori world view of 'Kaitiakitanga'- a way of managing the environment.

4.2.5 Students' behaviour towards food waste

Behaviour towards food waste is another important component of Food Waste Literacy. Therefore, the questionnaire had four questions (questions 5, 12, 14 and 15) which probed the students' behaviour towards food waste. Data about the behaviour component were also obtained from the Pre-intervention Focus Group Interview (PFGI).

The baseline question to explore the students' behaviour towards food waste, was question 5 in the questionnaire. The question was, "I try to eat all the food given to me" (see Table 4.6). The students were given flexibility in that question about eating all the food, by including the word 'try.'

Table 4.6 Students' behaviour towards food given to them (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
I try to eat all the food given to me. (Q.5)	2	7	9	1	1.79	2	0.79

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

The presence of the word *try* may have elicited agreement from nine students towards the response of eating all the food. This could mean that only these students reported positive behaviour towards finishing their food and hence preventing food waste. Whereas there were nine students who were not sure and one student who did not agree about finishing their food. These 10 students might never have experienced situations where not finishing all the food given to them was questioned, or disapproved of, by others. Hence these students might not have reported positive behaviour towards finishing all the food which is served to them.

The students' behaviour towards food waste was explored by another question in the Pre-intervention Focus Group Intervention. The students were asked, "Do you ever throw away food at home?." The students' responses were "yes I do," "yes sometimes," "yes" and "yes, my dinner, but since I live on a farm I just chuck it [food] outside for the animals to eat or if I can't finish anything I put it in my mom's or dad's plate." The students' reported behaviour indicated that they did throw away food or passed it to their family members to eat.

To explore the students' behaviour towards imperfect looking fruit and vegetables, the students were asked the following question: - "I would buy fruit and vegetables that are not perfect looking." (Question 12 in the questionnaire) (see Table 4.7). This question was asked to probe students' behaviour towards imperfect looking fruit and vegetables which encounter human rejection and hence end up being discarded and wasted.

Table 4.7 Students' behaviour towards imperfect looking fruit and vegetables (n=18)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
I would buy fruit and vegetables that are not perfect looking. (Q.12)	0	9	6	3	2.67	2.5	0.77

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

No student agreed a lot about buying fruit and vegetables, which are not perfect looking. Half of the students did agree to buy imperfect looking fruit and vegetables. However, the rest of the students were equally not sure or were not agreeing about buying fruit and vegetables that are not perfect looking. These nine students' reported behaviour indicated that they did not have positive attitudes towards buying imperfect looking fruit and vegetables. It may be due to their subjective experiences or social observations around them.

To further explore the students' behaviour towards food waste, they were asked a question about the use of leftover food bags/containers. This was Q. 14 in the questionnaire and was: - "When I cannot finish my food at a fast-food place or some other place, I ask to get it packed and take it home" (see Table 4.8). I asked this question as sometimes children eat outside their homes, with their families and they might have occasionally come across this situation. Even if the students had not witnessed this situation, they would have been able to answer this question based on their intended behaviour towards food getting wasted.

Table 4.8 Students' behaviour towards leftover food outside their homes (n=18)

	I rarely ask	I sometimes ask	I always ask	I always finish my food	Mean	Median	Std. Deviation
When I cannot finish my food at a fast-food place or some other place, I ask to get it packed and take it home. (Q.14)	3	8	4	3	2.39	2	0.98

Note. Options value. I rarely ask = 1, I sometimes ask = 2, I always ask = 3, I always finish my food = 4

Three students responded that they always finish their food and hence they felt there was no need to get the food packed and take it home. This indicated positive behaviour of these three students towards their food which avoided food waste. Three students chose the option 'rarely.' The choice of option of 'never' was deliberately avoided and instead the choice of 'rarely' was chosen because 'never' would have been an extreme option compared to 'rarely.' 'Rarely' provided more space for students to be honest with their choice in this question. There were eight students who chose 'sometimes' while there were four students who chose 'always' for getting their leftover food packed and taking it home. In all, there seemed to be 11 students who chose to indicate that they did not always get their leftover food packed and brought it home.

To gain more insight into the students' behaviour towards food waste, the students were asked an open-ended question (Q. 15) in the questionnaire. The question was, "What ways can you think of that people can help to reduce food waste?" Most of the students just wrote a few lines about ways to reduce food waste while two students wrote just a line each. The students wrote about: -

- "Giving leftover food to the pet animals."
- "Giving leftover food to someone else."
- "Just eating all the food."
- "Having a limit on buying the food."
- "Buying food which lasts longer."
- "Buying less food."

Some key ideas emerged for planning the components of an intervention, after analysing the students' responses which indicated the students' reported behaviour towards food waste. Some of the ideas which could be included in an intervention appeared to be: - the importance of eating mindfully, buying imperfect fruit and vegetables, importance of reducing food waste and exploring ways of reducing food waste.

4.2.6 Teacher's behaviour towards food waste

The class teacher was also interviewed to gauge her behaviour towards food waste. In response to the question "Are you aware of any initiatives in this school about dealing with food waste?," she said, "... so, like classes like me, we are like, if you don't want to eat your food, you don't put it in the bin, you take it home with you. You can take it back home." Her response indicated her positive behaviour ensuring food was not wasted in her classroom. She was asked if the students did think about food waste. She said, "No I don't think they [students] generally think about what [food] they throw out. What they know is Ms Lisa [the class teacher's pseudonym] is going to get angry." This statement indicated that the class teacher advocated against wasting food and was enhancing it by showing an angry behaviour over wasting food in the classroom.

4.3 Chapter Summary

This chapter presented the findings about Food Waste Literacy of the students and their class teacher. The students' and the class teacher's knowledge, attitudes and values, and behaviour towards food waste were explored, under their present status of Food Waste Literacy. The students' knowledge about food waste was explored using a questionnaire and a focus group interview. Data from these two sources indicated disagreements and uncertainty among the students, about the impact of food waste on the environment. The students were also not aware that varying amounts of resources are used to produce different food items. In general, the students were not aware about the places where food gets thrown away. The awareness about other places where food is also wasted like supermarkets, hotels, restaurants, farms and in transportation seemed to be missing. The students' responses about the various reasons for people wasting food were also presented. There was little awareness among the students about the end point in the journey of food waste. Further, the students could list only natural resources and machines as the resources used for producing food. The other important resources like money, human effort, and time were not mentioned by the students. The teacher's knowledge

about food waste was also presented in the chapter indicating her level of awareness about food waste in general and specifically in New Zealand. She was aware about food waste being a problem globally, but she did not see it as a considerable problem In New Zealand. She was not very aware about food rescue and reduction work being carried out in New Zealand.

The students' and the teacher's attitudes and values about food waste were also presented under the space of Food Waste Literacy. Data indicated that the students were not sure of sharing leftover food with guests if there was a special occasion in the family. There was an emphasis on 'special occasions' in the question as these are the events when more food than required, might be prepared in the families. However, the students' attitudes and values did not appear positive about sharing or distributing the surplus food, to avoid that food getting wasted. Some of the students reported throwing leftover food in rubbish bin. Findings also indicated that there was a significant number of students who were unsure about overbuying of food as one of the reasons for food waste. The class teacher's attitudes and values about food waste were also presented which indicated that she cared about food not being wasted and she was keen on her students becoming aware about food waste.

I finally discussed the students' and the class teacher's behaviour towards food waste. The students reported behaviour about eating all the food given to them indicated that almost half of the students were not sure or did not agree with finishing all the food given to them. Similarly, half of the students were not sure about buying imperfect looking fruit and vegetables. Data about reported behaviour towards leftover food at some eatery outside home, suggested that there were not many students who would ask for leftover food to be packed to be taken home. This indicated a lack of positive behaviour towards leftover food in an eatery which could be influenced by family/social circumstances. Findings about, ways by which people could reduce food waste, indicated that the students reported behaviour did not include many other preferred behaviours which can avoid food waste. The class teacher's responses indicated her positive behaviour towards food waste in the classroom which suggested her positive intentions for her students to develop their Food Waste Literacy.

The next chapter discusses the findings of the planning and designing of the intervention, based on the findings of the knowledge, attitudes and values, and behaviour of the students about food waste. It specifically answers the second research question, what kind of intervention might be designed and implemented to engage Year 7 students in developing their Food Waste Literacy.

Chapter 5: Planning a Food Waste Literacy Intervention as Guided-Inquiry

5.1 Overview of the chapter

This is the second of the three chapters on findings. In this chapter, I present the findings of the second research question about the planning and implementation of the intervention based on the pre-intervention findings of the students' knowledge, attitudes and values, and behaviour towards food waste, and some important ideas obtained from the literature. I start the chapter with the pre-intervention findings of the Food Waste Literacy of the students and the class teacher, followed by the pedagogical approach which was used in planning the Food Waste Literacy Unit as an intervention. The planning of the Unit as an intervention, its components, sequence and the justification of the teaching-lessons episodes included in the Unit are presented in the next sub-section. The chapter concludes with a summary of the chapter.

5.2 Pre-intervention findings about the students and the class teacher

The Food Waste Literacy (FWL) of the students and the teacher were explored under three aspects towards food waste - knowledge, attitudes and values, and behaviour. Many aspects about students' knowledge about food waste were probed and some of them are mentioned here. It was revealed that the students were generally not aware about why it is important to know about food waste. They were also not sure about the common reasons for food getting wasted and knowing about the usual places where food is wasted. There was also a lack of awareness about the amount of food being wasted in our day-to-day life and the loss of other resources which are used in the journey of food from farm to table. The students had mixed attitudes and values around food getting wasted as indicated by the findings that only some of the students thought about sharing leftover food. Some did not appear concerned about wasting food. Students' behaviour was also not found to be positive towards choosing imperfect looking fruit and vegetables or getting any leftover food at an eatery packed to be taken home.

The class teacher did not consider food waste to be a big problem in New Zealand. The teacher's attitudes and values towards food waste showed that she valued food not getting wasted and had been proactive towards avoiding food being wasted in the class. The teacher believed that teachers are responsible for developing and nurturing attitudes and values

regarding food waste in their students. The teacher had positive attitudes and values towards food, and she wanted her students to keep in mind the Māori world view of Kaitiakitanga- a way of caring for the environment. The teacher's reported behaviour indicated that she advocated against wasting food in the classroom.

An intervention was planned and designed based on these pre-intervention findings and some important ideas of Environmental Education and Environmental Literacy, which are presented in the next sub-section.

5.3 Pedagogical approach used

In order to improve and develop Food Waste Literacy of the students, a Food Waste Literacy Unit was constructed by me. This Unit was developed as an intervention and was approved by the class teacher. I used the pedagogical approach of teacher directed Guided-Inquiry, keeping the focus on the principles of Environmental Education and Environmental Literacy. The process of developing action competence, which is an overall objective of Environmental Education is also linked to the key competencies of *The New Zealand Curriculum* (Eames, 2010). The six aspects that support the development of action competence in students are experience, reflection, knowledge, visions for a sustainable future, action taking for sustainability and connectedness (Eames, 2010). All these aspects work together as reflection helps in the development of knowledge, which is being developed through experience. Moreover, taking action needs knowledge and the ability to connect that knowledge with issues. In practice, action competence in Environmental Education is learning about environmental issues so that students can plan and take informed action on those issues. In my study, the students' action competence was to be developed using Guided-Inquiry, which is a form of inquiry approach, with research at the centre of the learning. An inquiry approach helps to develop independent academic competence and also life skills in the learners (Kuhlthau et al., 2015). Guided-Inquiry is a pedagogical learning approach that involves students in finding out more information from different sources to have more understanding of a particular concept in a curriculum (Kuhlthau et al., 2015). Guided-Inquiry can engage, interest and challenge students and motivate students to question, explore and make new ideas (Kuhlthau et al., 2015; Tytler, Ferguson, & White, 2020). Under this approach, teachers guide the students, to use a wide variety of resources to address questions and explore ideas so as to have a deep

understanding for themselves. This Food Waste Literacy Unit was constructed for the intermediate school students aged 11 to 13 years old. Inquiry learning encourages students to pose thoughtful questions, explore widely, think critically (including analysing and evaluating information), develop a solution or formulate opinions, and evaluate and reflect on their learning (National Library of New Zealand, 2022). As, the intermediate students potentially “have the ability to recall, summarize, paraphrase, and extend ideas and to synthesize information in a new form for presentation to others” (Maniotes, 2016, p. 4), I decided to use this approach for the teaching-learning with this set of students.

The eight phases in a Guided-Inquiry, as described in Section 2.4.1.2 were used in this study. The Guided-Inquiry approach needs a lot of collaboration and planning between the teachers and the school librarians for making resources available to students. It also needs finding information, with time and schedule. I decided to use teacher directed Guided-Inquiry because of my limited time availability in the classroom. I was careful to negotiate the Guided-Inquiry with the class teacher even though I was allotted a fixed timetable and slots of 45 to 50 minutes, over a period of two months in which I had to implement the Food Waste Literacy Unit.

5.4 Planning of the Unit

5.4.1 *Planning of the Food Waste Literacy Unit*

The Food Waste Literacy Unit was planned after considering the findings from the student questionnaire, Pre-intervention Focus Group Interviews (PFGI) and the teacher interview, as well as the conceptual framework as shown in Section 2.7. The Unit was constructed with the advice and inputs from the class teacher keeping in view many unique aspects of the class and the school. The class teacher and I decided that the Food Waste Literacy Unit should be taught as a part of the sustainability theme as a topic under Science and Social Sciences. We also discussed that there should be 14 class episodes of about 45 to 50 minutes each. The class activities had to be planned, considering the learning objectives and key competencies of Science and Social Sciences of level 4 in *The New Zealand Curriculum*, the students’ previous knowledge, strengths, interests, needs, identities, languages and cultures. Moreover, another important aspect to be considered was that it was an accelerated class of the students and that they were extensively using Chrome books (small laptops) for learning at school. Therefore,

there was a conscious decision to include teaching-learning content which could be explored by the students using these devices.

5.4.2 Construction of the Food Waste Literacy Unit

The Unit was constructed keeping the components of Food Waste Literacy, Environmental Education, and Environmental Literacy in focus and using the teacher directed Guided-Inquiry approach. The sequence of the Unit consisted of 14 teaching and learning episodes (see Appendix K) and worksheets (see Appendix L) based on this overall flow of sequence (see Figure 5.1 below).

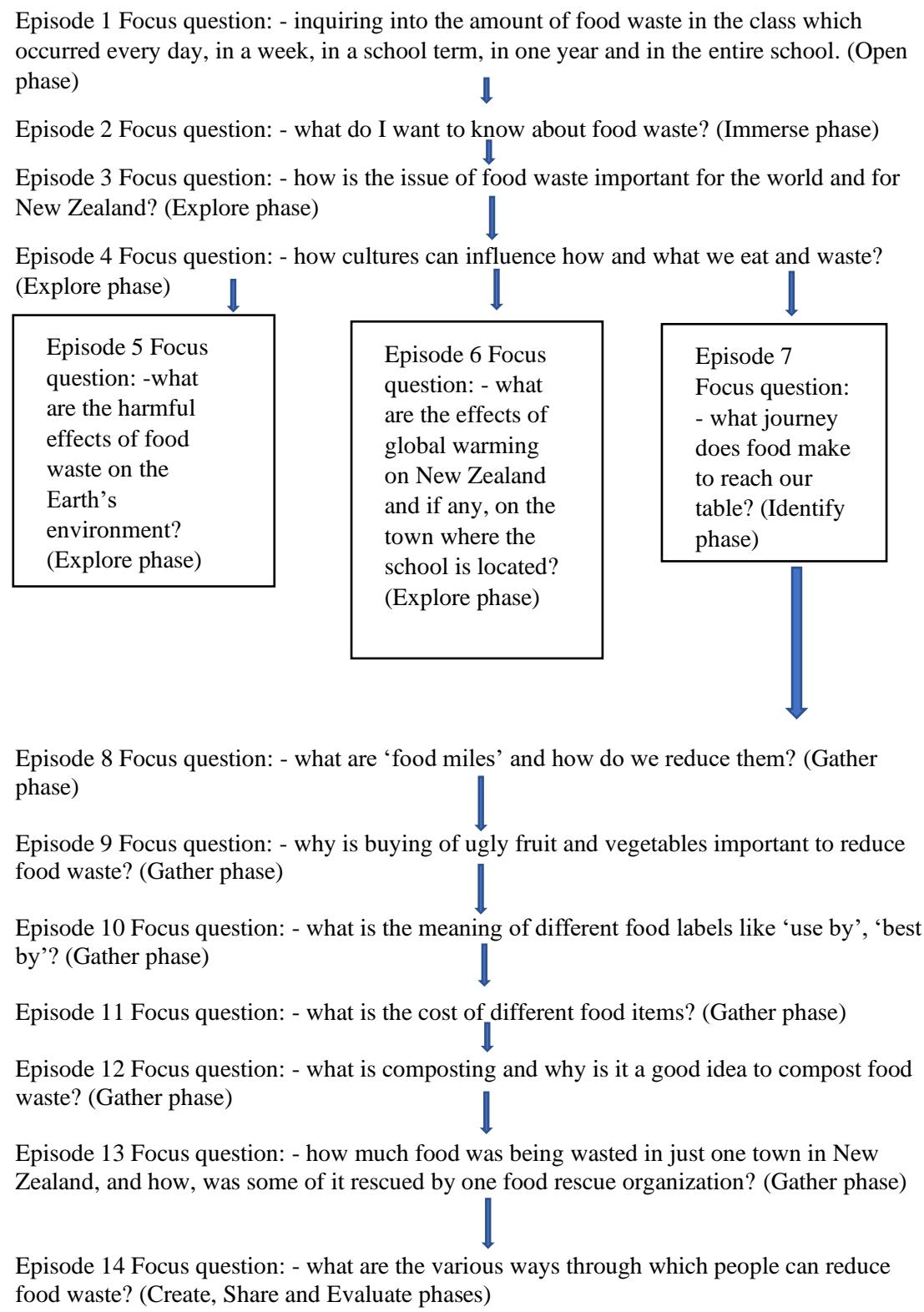


Figure 5.1 Overall plan of the activities

5.4.2.1 Open phase of the Guided-Inquiry

The first episode was based on the first phase, the Open phase of the Guided-Inquiry. This episode was planned around the Achievement Objective at level 4 of Science in *The New Zealand Curriculum* (Ministry of Education, 2007). The students would participate and contribute in the ‘Nature of Science’ by exploring various aspects of food waste. The focus question for the activity was ‘how much food from the students’ lunch boxes is wasted every day at school?’ The whole class would inquire into the amount of food waste in their class which occurred every day, in a week, in a school term, in one year and in the entire school. This activity was a hook to catch the students’ attention and spark curiosity and creating awareness about the amount of food being wasted in just their own classroom of 30 students in a day. This episode ended in the students becoming aware about the approximate amount of food being wasted in their school in one academic year. A worksheet (see Appendix L) and a class discussion followed at the end of the food waste audit, to raise awareness about a rough estimate of the quantity of food waste in different schools of New Zealand alone. The worksheet was planned in a way which would provide the students an opportunity to calculate the quantity of food waste in their classroom and the school in one academic year. This was done in an interesting way while carrying out the mathematical operations of multiplication and division. This activity had to provide a general idea about the amount of food being wasted in just one school in one academic year, with a size of about 650 students. At the end of this episode, the students reflected on the enormous quantity of food waste in schools in New Zealand and worldwide.

5.4.2.2 The Immerse phase of the Guided-Inquiry

The second episode (see Appendix K) was constructed keeping in mind the Immerse phase of the Guided-Inquiry. The focus question for the episode was ‘What do I want to ‘know’ about food waste?’ It involved reflection by the students to draw on their own knowledge about food waste and facilitating them to extend that knowledge, to learn more about the issue of food waste. This activity provided an insight into the students’ knowledge component of their Food Waste Literacy. The students had to reflect about what they already knew about food waste and what they wanted to know (inquire) about food waste. This reflection and writing were done on a KWL (K= what I know, W= what I want to know, L= what have I learned) chart (see Appendix L). The students had to complete the K and W component of the chart in a group of three to four students. The inquiry question for the students was ‘what do I want to know about

food waste.’ There was a discussion at the end of the activity which provided an opportunity to the students, to think and reflect about what they already knew about food waste and what more they wanted to know about it. This discussion was aimed at probing and adding to the students’ knowledge about food waste.

5.4.2.3 The Explore phase of the Guided-Inquiry

The third to sixth episodes were structured around the ‘Explore’ phase. The third teaching-learning episode (see Appendix K) was constructed to inquire about the scale of food waste in the world and in New Zealand. It was planned around the Achievement Objective at level 4 of Social Sciences in *The New Zealand Curriculum*, wherein the students understand that events (food waste) have causes and effects. The focus question for the episode was ‘how is the issue of food waste important for the world and for New Zealand?’ This episode enhanced the students’ knowledge component of FWL. The students viewed three videos about different aspects of food waste. All the videos shared in the classroom were approved by the class teacher, prior to viewing by the students. The first video was created by the not-for-profit organization, ‘Love Food Hate Waste New Zealand’ (LFHW) and was about food waste in New Zealand. The duration of this video was 4 minutes and 50 seconds (LFHW, 2016, May 11). Prior to the viewing, the students were informed about the video and the organization which had been carrying out the research work in New Zealand. The second video talked about the amount of food waste around the world (Fondazione Barilla, 2013, June 5). The duration of this video was 2 minutes and 12 seconds. The third video was about saving money by not wasting food (LFHW, 2016, May 24). The students were told before watching the videos that they should watch the videos carefully and ask any question, as they watched, relevant to the video and food waste. The videos were paused on several occasions so that the students’ queries about the quantity of food waste in the world and in New Zealand could be inquired into collectively. There was a worksheet (see Appendix L) which was based on the information in the three videos, viewed by the students. It was mentioned to the students that the worksheet was not a test, and the students could answer whatever they could remember. The students had to answer five objective type questions which were about the important information about food waste statistics in the videos. I felt that the act of writing these facts about food waste could help in reinforcing the knowledge gained by the students and the knowledge would stay with them for a longer time. To prepare the students for the next teaching-learning episode, they were asked to inquire about edible, potentially edible and inedible parts of any two fruits or

vegetables. They were also asked to inquire about any dish that could be prepared from parts of fruits or vegetables which are usually inedible. This inquiry was focussed on values and behaviour around the use of specific fruit and vegetables in individual households and cultures.

The fourth teaching-learning episode (see Appendix K) was planned around the Achievement Objective at level 4 of Social Sciences of *The New Zealand Curriculum*, so that the students could understand how people pass on and sustain culture (of food waste) for different reason. The inquiry question for the episode was ‘How cultures can influence how and what we eat and waste?’ This episode probed the students’ attitudes and values about food waste. The students had to share their findings of the inquiry about edible, potentially edible and inedible parts of any two fruits or vegetables, and dishes being prepared from the parts of fruits or vegetables which are usually inedible. The activity was planned to be carried out by the students in pairs. The students had to share their findings on a worksheet (see Appendix L) and later present it to the class. I followed it up by sharing an information sheet about edible, potentially edible and inedible parts of common fruit and vegetables on the class projector. I had prepared the information sheet and that included information about certain parts of some fruit and vegetables which are usually discarded in most of the countries but are consumed in other parts of the world. The information sheet was shared with the students in their Chrome-books which they could use for future reference. This was supplemented by a video which discussed about how to use parts of fruit and vegetables which are usually discarded. The duration of the video was 1 minute and 16 seconds (b/60, 2018, Oct 2). It was followed by a class discussion where the students shared their experiences about their eating habits about common fruit and vegetables available in New Zealand. This inquiry also gave an insight into some fruit and vegetables and /or their parts being eaten in some students’ households which may help in forming other students’ values around those foods.

The fifth and sixth teaching-learning episodes were part of one big focus on the inter-related concepts of food waste and global warming. It was constructed in a way that the big picture of the connection between food waste and its impact on our environment would be visible to the students. These episodes were focussed at developing the students’ knowledge component of the FWL. The fifth teaching-learning episode was thus once again constructed keeping the Achievement Objective at level 4 in Social Sciences of *The New Zealand Curriculum* in focus,

wherein the students would understand that events (food waste) have causes and effects. The inquiry question for the episode was ‘what are the harmful effects of food waste on the environment?’ The students were given the following inquiry questions- ‘do you think that food waste can have harmful effects on the Earth’s environment?, how do you think it can affect the environment?, have you heard about greenhouse gases and global warming?’ The students’ inquired about these questions, aided by the class teacher and me. Their responses were written down on the board and later discussed after watching four videos which were about the relationship between food waste, greenhouse gases and global warming. The first video focused on the relationship between greenhouse gases and global warming, and it had a duration of 4 minutes and 16 seconds (Callaghan, 2015, Aug 26). The second video was a presentation by the United Nations Environment Program (UNEP) and was of 6 minutes and 45 seconds duration (UN Expo, 2015, Jan 23). The third video was about environmental impact of food waste and was a 1 minute and 32 seconds presentation by the Food and Agricultural Organization (FAO) of the United Nations (FAO, 2017, April 3). The fourth video had information about the impact of food waste and was 1 minute and 43 seconds in duration (Halle, 2017, March 27). All these videos presented the connection between food waste and its impact on the global climate in an interesting manner and were considered age appropriate for these students by me and the class teacher. After reviewing and discussing the videos, the students worked on a worksheet which had multiple-choice questions. The worksheet helped the students to reinforce the new concepts and terms which they might have learnt while watching the videos. The students also had to demonstrate their understanding of the harmful effects of food waste on our environment, by making a drawing at the bottom of the worksheet. I provided opportunity to all the students to present and talk about their work to the rest of the class so that the other students could also get a chance to clarify their understanding about the harmful effects of food waste on our environment. This also led the students into their next inquiry about the harmful effects of food waste on New Zealand and on their particular town, if any.

The sixth episode (see Appendix K) was also constructed around the Achievement Objective at level 4 in Social Sciences of *The New Zealand Curriculum*, with the premise that the students would understand that events have causes and effects. The focus question of the episode was ‘What would be the impact of global warming on New Zealand and on the local life of this town?’ The students were asked to inquire if New Zealand would be affected by global warming. The students made inquiries in pairs, about this knowledge component of the FWL

on their chrome books and noted down their findings. They were helped in choosing and exploring age-appropriate websites. That was followed by a class discussion and viewing of two videos specifically about the impact of global warming on New Zealand. The first video was created by ‘The Deep South National Science Challenge, New Zealand’ and was of 1 minute and 48 seconds in duration (Deep South Challenge, 2017, April 30). The second video was a presentation by the National Institute of Weather and Atmospheric Research (NIWA) New Zealand and had a duration of 6 minutes and 30 seconds 9 (the video link is not working anymore but is available in the lesson plan). The students also watched two videos about the impact of global warming on the town in New Zealand where the study was carried out. These two videos were included to demonstrate the impact of global warming on the local life of the town which would help the students in relating more with this global phenomenon. One of the videos was about the recent flooding in this town and the other was about the threat to a local lake due to the changing global climatic conditions. Details of these videos are not included to preserve the anonymity of the school involved. The students also had to complete a worksheet (see Appendix L) which had a few multiple-choice questions based on the videos. The worksheet helped the students to choose an appropriate answer by reflecting on what they had understood from the videos.

5.4.2.4 The Identify phase of the Guided-Inquiry

The seventh episode was constructed focusing on the students’ knowledge, attitudes and values, and behaviour towards identifying resources which are involved in the journey of food from farm to table. The seventh teaching-learning episode was constructed, keeping in mind the Achievement Objective at level 4 of Science of *The New Zealand Curriculum*, with the expectation that the students would participate and contribute in the ‘Nature of Science’ by exploring the various aspects of the issue of food waste. The Achievement Objective at level 4 of Social Science was also kept in focus because during this episode the students would gain knowledge to understand how producers and consumers exercise their rights and how they should meet their responsibilities. The inquiry question of the episode was ‘what journey does food make to reach our table?’ The class discussion was planned around these questions- have you ever wondered from where, do we get bread?, how does it reach the supermarket?, what is it made of?. Similar questions about other food items like carrots, bananas, and milk were brainstormed. It was followed by viewing of five videos, so that the students could understand about the resources and effort which are required to make food available at table (The TESCO:

Eat happy project, 2014, Aug 6, 2014, Nov 22, 2014, Oct 7, 2015, Nov 13, 2015, Sep 30). My intention behind planning this episode was that the students would learn that wasting food is also wasting resources. The students could develop an understanding towards wasting less food or no food, by becoming aware of the resources used in making food available from farm to table. The students worked on a worksheet based on these videos followed by a subsequent class discussion on production, transportation, storage, and distribution of food. The worksheet had questions to probe the students' understanding of the journey of food.

5.4.2.5 The Gather phase of the Guided-Inquiry

The eighth to thirteenth episodes were constructed around the ‘Gather’ phase of the Guided-Inquiry. These episodes focussed on the knowledge, attitudes and values, and behaviour components of the students’ developing FWL. The eighth teaching-learning episode (see Appendix K) was once again constructed keeping the focus on Achievement Objective at level 4 of Science of *The New Zealand Curriculum*, expecting that the students would participate and contribute in the ‘Nature of Science’ by exploring various aspects of food waste issues. The inquiry question of the episode was ‘what are ‘food miles’ and how do we reduce them?’ In the activity, the students were asked to collect a few tins/boxes/wrappers/labels of fruits, vegetables, or any other food items. I had brought lots of food boxes/tins/labels/wrappers which were manufactured in different countries of the world. From the information on the food packets, the students had to locate the countries from where that food was imported or manufactured and write the details on a worksheet (see Appendix L). The students also had to locate these countries on a world map using their Chrome-books. I used a big physical map of the world to point out and mark all the countries, from where food is imported into New Zealand. The students were also asked to inquire about the different means of transport which would be used to make those food items available in New Zealand. This activity was planned so that the students could develop an awareness that buying food which is imported from outside the country uses more resources than buying food which is made locally or in the country. Hence, wasting that food incurs a greater loss of resources and money. With this activity, I wanted the students to inquire about the concept of food miles and its implications for food waste. The students could learn about food miles, which is the distance that food travels from where it is grown to where it is ultimately purchased or consumed by the end user. The activity was supported by an online activity (VeggieTrumps, 2017). The students used their Chrome-books to calculate food miles of different food items which are imported to New

Zealand. By doing this activity, the students could realize that the farther the food travels, the more food miles it covers which adds more carbon dioxide to the environment. The students also discussed about the extent and the conditions under which one supply chain can be more environmentally efficient than another one, without being introduced to the term ‘Life Cycle Assessment (LCA).’ The online activity made the students aware about the long distances some food has to travel before it reaches the consumers, which may also lead to waste of perishable food items in the food supply chain. The food loss and waste along the food supply chain happens at production, harvest, transportation, storage, retail, and consumer levels. The students could explore the food loss and waste associated with the journey of food, before it reaches our plates, with the help of the videos shared in the previous teaching-learning episode and appreciate the importance of food miles in food wastage.

The ninth episode (see Appendix K) was focused on the Achievement Objective at level 4 in Social Sciences of *The New Zealand Curriculum*, so that students would gain knowledge and experience to understand how people pass on certain cultures (of discarding ugly fruit/vegetables) for different reasons and that this has consequences for people. This episode was focussed on exploring the attitudes and values, and behaviour around imperfect looking fruit and vegetables. The focus question for the episode was ‘why is buying of ugly fruit and vegetables important to reduce food waste?’ I started the teaching-learning episode by asking the students to draw a fruit or vegetable of their choice on a worksheet. Some misshapen and bruised, and some perfect looking fruit and vegetables were demonstrated to the students, which were followed by these discussion questions- which fruits/vegetables would you buy out of the two lots? why? why not? The students had a class discussion around these prompts and also viewed two videos about the rejection of imperfect looking fruit and vegetables by the producers and the consumers (Katie, 2017, May 15; The New York Times, 2015, Nov 26). This episode was designed for the students to learn that such fruit and vegetables form about 10% of the food waste globally. It was aimed at creating an awareness, about buying such misshapen fruit and vegetables, and an understanding that those fruit and vegetables are equally good in terms of nutrition and taste. The students could also observe a huge collection of pictures of imperfect looking fruit and vegetables on a website on their Chrome-books (Uli Westphal, 2018). At the end of the class discussion, which was mediated by the class teacher and me, the students were asked to draw the same fruit or vegetable which they had drawn earlier but an imperfect looking one this time (see Appendix L). They were then asked to

choose between the perfect or the imperfect fruit or vegetable and provide a reason for choosing that one. This activity of choosing a reason for selecting either the perfect or the imperfect fruit/vegetable was designed so that the students could reflect about their attitudes and values towards these different looking fruit and vegetables. I considered that this reflection might indicate the students' learning about the goodness of imperfect looking fruit and vegetables. The students shared their drawings and choices of fruit and vegetables with their peers which might have helped other students to wonder about their choices. At the end, I offered those imperfect looking fruit and vegetables to the students and those samples were quickly taken away by the students. That might demonstrate and add to the developing positive attitudes and values of the students towards these imperfect looking fruit and vegetables. At the end of the ninth episode, the students were asked to bring some empty food packets/tins for a class inquiry in the next class session.

The tenth episode (see Appendix K) was constructed for the students to learn about the differences between the different types of food labels. This episode was planned as a lot of food is wasted in the absence of a clear understanding of the true meaning and implications of food labels, especially 'use by' and 'best by.' The episode had the Achievement Objective at level 4 of Science of *The New Zealand Curriculum*, so that the students would participate and contribute in 'Nature of Science' by exploring various aspects of food waste issues. The inquiry question for this episode was 'what is the meaning of different food labels like 'use by,' 'best by'?' The students identified the labels 'use by' and 'best by' on the food packets/tins which were brought in the classroom by the students and me. The food packages that were used as examples were of the items that are commonly used in most of the households. This activity was planned so that the students could comprehend the use of different food labels on different food items. The students also inquired more about the food labels from the website of the Ministry for Primary Industries (MPI) of the New Zealand government (MPI, 2021b). They also watched a video to comprehend food labels (foodstandardsanz, 2010, Mar 10). The activity concluded with the students searching on the website and writing on a worksheet, about five food items each, under the 'best by' and the 'use by' dates (see Appendix L). The worksheet provided an opportunity to the students to contemplate about the relevance of the food labels for different food items.

The eleventh episode (see Appendix K) was constructed around the inquiry question ‘what is the cost of different food items?’ It was aimed at the Achievement Objective of level 4 of Mathematics of *The New Zealand Curriculum*, so that the students could engage in thinking mathematically in a meaningful context (cost of food items). This episode was planned to provide an opportunity to the students to carry out an inquiry about the cost of different everyday food items which might make them more aware of their cost and might lead them to think twice before wasting food. The students worked in groups of three and completed a virtual, online grocery shopping exercise in an allotted budget of 100 dollars for a week for a family of five members. The students had to use their Chrome-books to find the costs of common foodstuffs like milk, eggs, bread, meat, juice, potatoes, onions etc in the different supermarkets in New Zealand like Pak’nSave, Countdown and others, and find out how much each product would cost. The students entered their findings in a worksheet (see Appendix L) which had tables of food item, quantity, and cost of each item. At the end of the inquiry, the students had to share about how they felt about wasting food. I decided to include this learning experience because it provided an opportunity to the students to gain knowledge about the cost of some common food items, and also to realise the amount of money that gets wasted by wasting that food.

After the completion of the eleventh episode, the students were guided to inquire about the ways of preventing food waste. At that point of time, I decided to move further on the path of developing the students’ Food Waste Literacy from knowledge to action. The students had had exposure to more knowledge about food waste and its related aspects, and they were ready to inquire about ways of reducing and handling food waste. Therefore, the next two episodes were constructed keeping in focus the reduction and recycling of food waste.

The twelfth episode was directed at the ways to reduce food waste by recycling it. The students had to share about their inquiry, with their peers, about the different ways of reducing food waste, including composting food waste. I thought that it was a good next step for the students to inquire about composting food waste as students would have an ease of doing it at school and/or at home. The focus question for the teaching-learning episode was ‘what is composting and why is it a good idea to compost food waste?’ The planning was around the Achievement Objective at level 4 in Social Sciences of *The New Zealand Curriculum*, so that the students

could gain knowledge to understand how people participate individually and collectively, in response to community challenges (food waste in the context of this intervention). The learning objective for this activity was that the students could learn that composting food waste is a better solution than letting the food waste go into the rubbish bin and ending up in a landfill. Thereafter, the students had the opportunity to view two videos (HCDOES, 2011, May 27; HighfieldsComposting, 2014, Feb 6) about the use of compost bins which helps to reduce food waste in a useful and a harmless manner. The students also viewed a short video about food waste being converted to useful compost in Resource Recovery Park at Timaru, New Zealand (Holden, 2018, April 4). Following the viewing, the students had to complete a worksheet where they had to decide and choose the food items that could be put in compost bins for recycling of food waste. The students were guided to inquire about some of the food items in the worksheet, as those foods were not included in the videos. The students had discussion with other students and with the class teacher and me, about specific foods that could or could not be put in compost bins. These discussions with some students helped in supporting them to construct knowledge about compostable and non-compostable foods which was then passed on to the other remaining students in the class too.

The thirteenth episode was constructed keeping in focus, the reuse and recycling of food waste. Therefore, I organised a talk-cum-demonstration by a local food rescue worker, about food waste and food rescue efforts in the town. The planning for this episode was around the Achievement Objective at level 4 in Social Sciences of *The New Zealand Curriculum*, to help the students understand how people participate individually and collectively in response to community challenges (food rescue and reuse in this context). The students were provided an opportunity to know more about food waste from other sources and help in the construction of the knowledge component of their developing FWL. The food rescue worker had planned to present about the amount of food waste by just one major supermarket, Countdown, in the town. The food rescue worker also shared with the students how the food donated by the supermarket and some more eateries in the town, was made available to the people who could not afford to buy their own food. The focus questions for the activity were ‘how much food was being wasted in just one town in New Zealand, and how, was some of it rescued by one food rescue organization?’ The food rescue worker came to the school with his food van, loaded with the donated food which he had received that day from the supermarket. He brought in some crates of food to the class for the students to see the quality and the quantity of food being

wasted by the supermarket. The students had an opportunity to listen and interact with the food rescue worker. The learning objective for this activity was that the students could develop an understanding that on the one hand, so much food is wasted while on the other there are so many hungry people in the town. As a probable impact of this intervention, the students asked for that food for themselves to consume as they did not view it as inedible anymore. The students also had a chance to calculate the amount of food being wasted by just one supermarket in their town. The results of that calculation were to be used for a further class discussion on the approximate amount of food waste in the town, including other supermarkets, homes, and other eating places.

5.4.2.6 The Create and Share phases of the Guided-Inquiry

The fourteenth episode (see Appendix K) was constructed keeping the focus on the Achievement Objective of level 4 in Social Sciences in *The New Zealand Curriculum*, so that the students would understand how people can participate individually and collectively in response to community challenges (food waste). The episode was planned around the focus question ‘what are the various ways through which people can reduce food waste?’ This episode encompassed the ‘Create’ and ‘Share’ phases of the Guided-Inquiry. The students had to share their understanding as a ‘Culmination’ phase of the Guided-Inquiry. The students had to demonstrate their understanding of the ways to reduce food waste by using any means of presentation, such as preparing a mind map/poster/brochure/PowerPoint, drafting a poem/short story etc. They were asked to present individually and share their understanding with the rest of the students, in any way that they felt was appropriate. This individual presentation by the students provided an insight into their overall learning about food waste and knowledge of ways to reduce it.

5.4.2.7 The Evaluate phase of the Guided-Inquiry

As a part of the ‘Evaluate’ phase, the students were asked to complete the L (what I have learned) part of the KWL chart which they had left incomplete during the second teaching-learning episode. The students reflected on the content and process of inquiring about food waste by completing the KWL and by discussing which contents and activities they liked and why. This was planned to be a longer class than the usual class of 45 to 50 minutes in duration, where the students could share their understanding and any change in knowledge, attitudes and

values, and behaviour towards food waste. As a part of the reflection on the process, the students wanted to share it with other students in school. The class teacher organised a special school assembly where these students shared their understanding of food waste with the rest of the students.

5.5 Chapter Summary

The chapter has presented the planning of the intervention as a teacher directed Guided-Inquiry, based on the pre-intervention findings of the students' and the teacher's knowledge, attitudes and values, and behaviour towards food waste. The pre-intervention findings were used to construct the Food Waste Literacy Unit adopting the Guided- Inquiry as the pedagogical approach and keeping in sight, Environmental Education and Food Waste Literacy. The Unit consisted of 14 episodes which were constructed by me and approved by the class teacher. The first episode was the 'Open' phase of the Guided-Inquiry which would spark students' curiosity about the amount of food waste in their own school. The second episode was the 'Immerse' phase where the students were to be guided to connect with the content they already knew, and to think about further exploration about food waste. It was to be carried out by using a KWL chart. It was the 'Explore' phase of the Guided-Inquiry which continued from the third to the seventh episodes. Under this phase, the students continued to explore and find new information about food waste, guided by me and their class teacher. These episodes involved inquiring about- the scale of food waste in the world and in New Zealand, how cultures may influence what parts of the fruit and vegetables are eaten and what are discarded, effect of food waste on our environment, effect of global warming on New Zealand and on the town where the school was situated, and impact of food waste on our resources in the journey of food from farm to table. I felt that by the end of the seventh episode, the students would have understood that food waste and its related aspects needed some more exploration.

Therefore, the next few episodes were planned under the 'Gather' phase of the Guided-Inquiry. These episodes continued from the eighth to the thirteenth episode and were directed by me and the class teacher. During these episodes, the students learnt about- food miles, imperfect looking fruit and vegetables, 'use-by' and 'best-by' on food labels, cost of day-to-day food items, composting food waste and rescuing food waste. The Guided-Inquiry approach for Food Waste Literacy Unit ended with the students 'Creating' and 'Sharing' their understanding of

food waste with their classmates, other students and teachers in the school, and ‘Evaluating’ the content and process of their learning of food waste.

The next chapter discusses the post-intervention findings after the completion of the Food Waste Literacy Unit. It specifically answers the third research question ‘how does an intervention activate Year 7 students’ inquiry and decision making in Food Waste Literacy?’

Chapter 6: Post-Food Waste Literacy Intervention as Guided-Inquiry

Findings

6.1 Overview of the chapter

This is the last of the three findings chapters. This chapter addresses the third research question - how does an intervention activate Year 7 students' inquiry and decision-making in Food Waste Literacy? In section 6.2, I present the post-Intervention findings about the Food Waste Literacy of the students under the three aspects of knowledge, attitudes and values, and behaviour towards food waste. It is followed by a section on the Food Waste Literacy of the class teacher. The summary of the chapter forms the last section.

6.2 Food Waste Literacy (FWL) of the students

After the intervention was over, the students' responses were probed for any changes in their decision-making regarding food waste and their overall Food Waste Literacy. All the students were invited to complete a questionnaire with the same items as in the pre-intervention questionnaire. All the 19 students, also participated in Post-Intervention Focus Group Interviews (PoFGI). The PoFGI had four questions which were additional to the questions in the Pre-Intervention Focus Group Interview (see Appendix F). In these questions, the students were specifically probed about any change in their awareness, attitudes and values, and behaviour towards food waste, the most surprising learning about food waste that the students would like their family and friends to know, the activities which the students liked the most and the reason for liking those activities. The findings about the different aspects of the Food Waste Literacy of the students and the class teacher in response to the intervention are presented below, along with the comparisons to the pre-intervention data. These findings are supported by the observations made during the teaching-learning episodes in the classroom. These observations were recorded in the Students' Engagement Observation Form (see Appendix G). The engaged students were observed for the following:

1. Listening - to the teacher/researcher, focus on the teacher/activity, making appropriate facial expressions, gestures, and postures.
2. Responses - asking questions, answering questions, and participating in class discussions.
3. Behaviour - involved and showing interest and liking the teaching material.

I also recorded anecdotal observations during the various teaching-learning episodes. I took feedback from the class teacher after each episode and asked for any suggestions so that this Unit can become more effective and useful for any future use by me or some other teacher/researcher.

6.2.1 Students' knowledge about food waste

As discussed in Chapter 4, there were a total of 15 questions in the questionnaire (refer to Appendix B). There were eight questions to probe students' knowledge about the food waste and they were question numbers 4, 6, 7, 8, 9, 10, 11 and 13. In the questionnaire the students were asked to choose their agreement to statements in these questions, with options ranging from agreeing a lot, agreeing, not sure to don't agree. For the purpose of analysis, values were assigned for these options as 1, 2, 3, and 4, respectively. Data about the changes in the students' knowledge component of Food Waste Literacy were also obtained from Post-Intervention Focus Group Interview (PoFGI). There were five questions which probed the knowledge aspect of the Food Waste Literacy of the students in the PoFGI. All the students were divided into four groups and their responses to various questions are also presented here.

6.2.1.1 Students' knowledge about the impact of food waste on the environment

All the 19 student participants gave responses for the questions about the knowledge component of the Food Waste Literacy of the questionnaire. Firstly, I present questions 4 and 9 which probed the students' awareness about the consequences of food waste on the environment which is a vital component of Food Waste Literacy. The post-intervention data for these two questions are shown in Table 6.1 which presents the number of responses, the means, the medians, and the standard deviations (σ) for the two items alongside the same data from the pre-intervention questionnaire.

Table 6.1 Students' awareness of the consequences of food waste on the environment (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
Pre-Intervention (Q.4)							
When people throw away food, it causes environmental problems.	2	7	9	1	2.47	3	0.77
Post-Intervention (Q.4)							
When people throw away food, it causes environmental problems.	14	5	0	0	1.32	1	0.48
Pre-Intervention (Q.9)							
Food that is thrown away produces gas which is harmful to the environment.	3	2	12	2	2.68	3	0.89
Post-Intervention (Q.9)							
Food that is thrown away produces gas which is harmful to the environment.	13	5	1	0	1.21	1	0.42

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

After the intervention, there was a shift in the students' responses towards an agreement that food which is thrown away causes environmental problems. The shift represented a change from some agreement and uncertainty (pre-intervention) to complete and strong agreement, with a low deviation in this position in the group (post-Intervention).

The students also showed an enhanced understanding about the environmental implications of wasted food. Before the intervention, only 5/19 students had agreed to the relationship between wasted food and harm to the environment. After the intervention, 18/19 students agreed with this relationship. These findings suggest that an enhanced environmental awareness occurred during the period of the intervention. The class observations, during the teaching-learning episodes 5 and 6 where the environmental impact of food waste on the world and on New Zealand was discussed, also indicated a growth in knowledge about food waste. The students were viewing and discussing the videos which showed the impact of food waste on our environment and asked many relevant questions like "then we should all have electric cars?," "why are we raising so many cows/cattle for meat, if they contribute to global warming?" and "when will life finish on Earth because of global warming?" One of the students commented, "we must visit the local landfill and see how the food rots" as he was curious to know about what happens to food waste being taken away by the kerbside trucks and thrown in the local

landfill. The students were watching a video on the effects of global warming specifically on this town, as food waste also contributes to global warming. After watching that news video about the endangered bird (kiwi) on an island being affected by the rising water levels in the local lake in the town, one student said, “so sad to know that the kiwis [birds] on this island [in the town] will die due to starvation.” The students could see in the video that on the one hand, the lake water level is rising. On the other, there are drought like conditions on that island in summers, due to the changing climate conditions. The students could relate that the wasted food also impacts the environment and causes environmental problems. In the final presentations, some students created posters. Figure 6.1 shows one of these (for some more samples, see Appendix M). This poster was created by Olivia and the overall message that was conveyed by her was the environmental impact of food waste. She had beautifully depicted the uniqueness of some fruit and vegetables by stringing them in vibrant colours, in the title. She had included some food items like bread, apples, and bananas which are commonly wasted globally and in New Zealand. She had clearly communicated the overall impact of food waste landing in landfill, which is shown to be emanating harmful greenhouse gases into the environment, which is making the Earth sad. She had been able to communicate her understanding about the relationship between food waste, landfill, greenhouse gases and global warming. She had also offered a detailed explanation of composting as a suggestion to reduce this environmental impact of food waste. Her use of the drawing of heart with a sad expression and details of food waste and greenhouse gases, and another drawing of the Earth shedding tears over the landfill, also expressed her attitudes and values towards food waste.

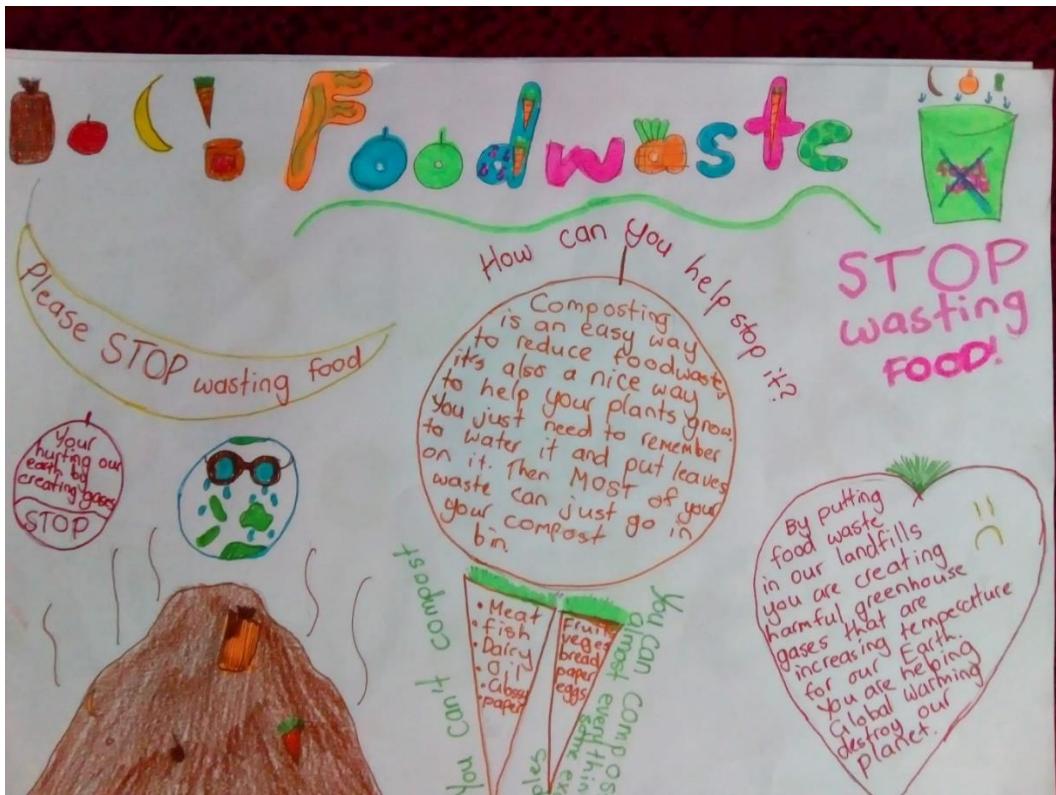


Figure 6. 1 Olivia's Poster

The opening question in the PoFGI “What comes to mind when you hear about food waste?” received diverse responses from the students. Some of them visualized leftover food, some thought of the harmful effects of food waste on our environment, while some thought of leachate and rejecting imperfect looking fruit and vegetables. In thinking about leftover food going to waste, one student said, “How most food umm like some food doesn’t end up going into the fridge for tomorrow and will usually end up in the bin” and another said, “I think about people storing their food poorly and then [saying]it is not in the right condition.” A number of students focussed on the harmful effects of food waste on the environment, with one stating “that it [food waste] can harm our Earth,” while another said, “it [food waste] spoils water and soil and other stuff” and a third elaborated that “when I think of food waste I think of methane from landfills.” Two students specifically mentioned food waste creating leachate in landfills, saying “I think about leachate” and “if you don’t store your food properly and then chuck it in the bin, then it ends up in the landfill and creates leachate.” Some students also focussed on the wasted food that is fit to eat. One of the students said, “the food which is thrown away which is perfectly fine” and another said, “the type of food that looks bad from outside, but it is absolutely fine from inside.”

Furthermore, what was on top of the mind for several students was the need to address the issue. As one said “I feel that we have to do something about it. Food waste is not the right thing to do, and we should teach other people if they do, how not to. Try this, try that. Tell them what happens.” and another commented “I feel like sad that it causes umm global warming and stuff and I feel like telling others to stop doing it because of that also.” One student acknowledged a specific intervention effect in their comment that “I just think of Deepa [me] whenever I throw something away and I think that Deepa will not be happy.”

The students were able to think and respond about many different perspectives of food waste. The students’ environmental awareness appeared to be enhanced because of the intervention. They were able to articulate concern about impact of food waste in general and on the environment in particular. The students also began to focus on how to address the food waste issue. It appeared like the beginning of the development of the concept of food citizenship among the students.

6.2.1.2 Students’ knowledge about ‘where’ and ‘why’ of food waste

The students’ knowledge about ‘where’ and ‘why’ aspects of food waste were probed through the following two questions (Q.10 and 11 in the questionnaire). These questions were about the places where food waste takes place that may have been familiar to the students, and the common reasons for food getting wasted. The post-intervention data for these two questions are shown in Table 6.2 which present the number of responses, the means, the medians, and the standard deviations for the two items alongside the same data from the pre-intervention questionnaire.

Table 6.2 Students' awareness about common places for food waste (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Dev.
Pre-Intervention (Q.10)							
I think food could be wasted in New Zealand in these places:							
a) on farms	2	1	11	5	3.0	3	0.88
b) when it is being transported from place to place	0	7	8	4	2.84	3	0.76
c) In supermarkets	2	5	7	5	2.79	3	0.98
d) In homes, marae, restaurants, and hotels	2	9	6	2	2.42	2	0.84
Post-Intervention (Q.10)							
I think food could be wasted in New Zealand in these places:							
a) on farms	7	8	3	1	2	2	0.88
b) when it is being transported from place to place	3	9	7	0	2.21	2	0.71
c) in supermarkets	11	7	0	1	1.42	1	0.77
d) in homes, marae, restaurants and hotels	13	5	0	1	1.42	1	0.77

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

There was a noticeable shift amongst the students towards agreeing about the loss of food in the entire food supply chain. The change indicated a shift from uncertainty and disagreement to strong agreement, with a low deviation in this position. Pre-Intervention, a few (3/19) students agreed that food could be wasted in New Zealand on farms. However, after the intervention many more (15/19) students agreed that food waste could take place on farms in New Zealand.

There was a shift in the students' responses about food being wasted at other places in the food supply chain, like in transportation, in supermarkets, in homes and other places for eating food indicating a discernible change after the class intervention. Pre-Intervention, less than half (7/19) of the students agreed with the idea of food being wasted in New Zealand during transportation. Post-Intervention, more than half (12/19) of the students agreed to food being wasted during transportation. In the pre-intervention survey, it was seen that less than half of the students (7/19) were agreeing about food waste happening in supermarkets and a few more students (11/19) agreed to food being wasted in homes, marae, restaurants, and hotels in New Zealand. However, post-intervention, almost all the students (18/19) agreed to food being wasted in these places.

Students were also asked about the different reasons for food getting wasted (see Q.11 in Questionnaire). The post-intervention data for the question is shown in Table 6.3 which presents the number of responses, the means, the medians, and the standard deviations for the item alongside the same data from the pre-intervention questionnaire.

Table 6.3 Students' awareness about reasons for food waste (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Dev.
Pre-Intervention (Q.11)							
I think, people waste food when they:	4	9	5	1	2.16	2	0.83
a) buy too much food							
b) don't eat leftovers	7	8	3	1	1.84	2	0.83
c) store food poorly	3	9	7	0	2.21	2	0.71
d) don't understand food labels	0	3	15	1	2.89	3	0.46
e) cook too much food	1	9	6	3	2.58	2	0.84
Post-Intervention (Q. 11)							
I think, people waste food when they:	14	5	0	0	1.32	1	0.48
a) buy too much food							
b) don't eat leftovers	8	11	0	0	1.68	2	0.58
c) store food poorly	11	7	1	0	1.53	1	0.70
d) don't understand food labels	11	4	4	0	1.63	1	0.83
e) cook too much food	8	9	2	0	1.68	2	0.67

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree =4

A shift was seen in the students' responses towards agreeing that overbuying of food is one of the reasons for food waste. This shift represented a change from less agreement and a little uncertainty to more agreement and certainty, with a low deviation in this position. In the pre-intervention survey, very few students (4/19) agreed a lot, with the fact that people waste food because of overbuying. But after the intervention, many more (14/19) students agreed a lot with this reason, which indicated a change in the students' awareness about people overbuying food. After the class intervention, all the students had agreed about people wasting food by not eating their leftovers. There was also a change in the students' responses in agreeing a lot (from 3/19 to 11/19) about the fact that people waste food when they store food poorly. Post-Intervention, there was also a jump in students' responses from 0/19 to 11/19 who agreed a lot that people waste food when they do not understand food labels. After the intervention, there was a big decline in the number of students who were not sure about this fact. Initially quite a

few students (15/19) were not sure about food being wasted because of the lack of understanding of the food labels in contrast to 4/19 students at the end of the intervention. Overall, the post-intervention responses indicated a better connection of the students with the reasons for food waste which is an enabler to develop food citizenship and Food Waste Literacy.

Further exploration and understanding of the students' knowledge about this aspect of Food Waste Literacy was supported by including three open-ended questions in the questionnaire. The first question towards exploring this aspect was "Can you think of some places where food is wasted?" A wide variety of places were mentioned by the students in response to this question in the PoFGI. Before the intervention, the students had mainly talked of homes and restaurants where food is wasted. But after the intervention, the students' responses included almost all the usual places where food waste commonly takes place, in the entire food supply chain. They could respond about food waste taking place on farms, supermarkets, homes, restaurants, hospitals and almost everywhere. The students could respond that food waste process starts right from farms, and they were able to support their responses with the reason behind it. One student said, "farms because anything that looks good, they pick up but anything that looks different, they just chuck out because they know that no one will buy it because it looks so weird." While other students said "farms, houses, the imperfect looking ones and the ones which are not the right size. They don't get used because they don't look perfect, or they are not the right size. So, they get thrown away as they are imperfect, and nobody is going to buy them." Another student said, "restaurants, when we don't finish our food," while another said, "restaurants, hotels basically anywhere." The students seemed more aware about the places where food is wasted and not just the households. They knew about food being selectively wasted on farms and supermarkets and the reasons for such a waste. There was a growing connection between the places where food is wasted and the reasons why it gets wasted.

Places where food waste occurs was also probed by asking 'In what sorts of places does food get thrown away?' Pre-Intervention, most of the students could only think of our natural environment like seaside, parks, for disposing of food waste. But Post-Intervention, the students had a wide range in their responses and could give examples of food also getting thrown away at factories, supermarkets, homes, restaurants, hotels, fast food places, motels,

and shops. The students' responses had become more specific about many more places where food is thrown away in its journey from farm to table rather than just the places where it is thrown away by people as consumers at the final step of the food supply chain.

There was a big jump in the students' response after the intervention, about food being wasted due to poor understanding of food labels. In the class observation of teaching-learning episode 10 which was based around understanding different food labels it was seen that the students were very eager to understand the food labels. Most of the students commented that they were not aware of these food labels on the food boxes and were also not aware of how to interpret them. Post-intervention, the students appeared more confident about the common food labels like 'use by' and 'best by' and decided to make their decision about discarding the food item based on their newly acquired understanding of food labels. Finally, there was an increase in students' awareness about food being wasted as a result of too much food being cooked. Before the intervention, only one student had agreed a lot with the statement that people waste food when they cook too much food. But post-intervention, there was a notable change, with many more (9/19) responses in agreeing a lot with this statement. The students seemed more aware about peoples' behaviour, which results in food getting wasted.

6.2.1.3 Students' knowledge about the waste of resources in food waste

To probe the students' knowledge about the waste of resources when different foods are wasted, they were asked the question, "We waste the most energy when we throw away which of these foods?" The Post-Intervention data for this question is shown in Table 6.4 which presents the number of responses, for the items alongside the same data from the Pre-Intervention questionnaire.

Table 6.4 Students' awareness about waste of energy associated with food waste (n=19)

Food item	No. of students (Pre-Intervention)	No. of students (Post-Intervention)
bread	4	2
egg	6	0
beef	4	17
banana	5	0

Overall, it indicated an expansion in knowledge about this aspect of food waste. After the intervention, most of the students (17/19) were aware that wasting beef leads to wasting of more energy and resources compared to the other food items.

To supplement my understanding of the students' level of awareness, about the food waste and the waste of resources associated with it, an open-ended question 'What resources are used for producing food?' (See Q.8 in Appendix B) was also posed to the students in the pre-intervention questionnaire. The students had written many man-made and natural resources for producing food. The students' responses included 'containers,' 'electricity, fertilizer, chemicals' and 'farms, water, sunlight and soil.' However, no responses mentioned other valuable resources like money and human effort which are also wasted when food is wasted. There was only one student in the Pre-intervention Focus Group Interview (PFGI) who said, "I feel sad about it [food] because you work so hard for that money, and you are going to buy something [food] that will never be used." After the intervention, many more resources were mentioned by the students in response to this question. The students could write about resources which included man-made and natural resources like big machines, processors, packaging machines, petrol, trucks, ships, big machines like harvesters and pickers, water, soil, animals, sunlight etc. The students also wrote about time, energy, money, work, and effort involved in producing food. After the intervention, the responses had become more relevant and connected with the journey of food from farm to table. I could support these findings with my class observations made during the teaching-learning episodes 7 and 8, which also indicated a growing awareness of the resources which are used in food production. These two episodes were about the journey of food from farm to table and the food miles. The students were very keen to learn about the long and expensive journey of food which is not grown locally. They asked many questions like, "how much food waste does an individual waste in his lifetime?" One student commented, "food comes from supermarkets, right?" as he sounded unsure about the places where different foods are produced or manufactured. One student sighed and said, "humble carrot" while watching the video which showed the production of carrots. Another student said, "we spend money on such big machines and then throw away food which is produced by using them, sad." The students seemed more aware about the aspect that every time food is wasted, all the resources that are used in the different stages of its production are wasted too.

6.2.1.4 Students' knowledge about types of food waste

To assess the students' knowledge about types of food being wasted, the students in the focus group were posed the question, "What kinds of food do you think people waste?" Pre-Intervention, the students' responses were limited to listing day to day food items such as bread, fruits etc. But post-intervention there was a wide range of food items in the students' answers. The students also supported their choice of food items that are wasted, with the reasons for those items being wasted. The responses included imperfect looking fruit and vegetables. One student said, "everything people don't like or weird looking stuff or imperfect looking fruit and vegetables." Another student said, "we are wasting fruit and vegetables and weird ones like carrots which are twisted or have grown together or basically anything that has a blemish or something." Three other students responded, "fruits that are not right or look weird," "food that doesn't look perfect" and "lots of food that looks out of the ordinary, but they are completely fine." The students could also give examples of leftover food and foods with misunderstood labels, as another category of food being wasted. One student responded, "any leftovers that nobody eats or anything you feel has gone bad like anything that says, 'best before' that you don't know." While another student said "I used to think that 'best before' is the expiry date. Like I thought that it [food] must have gone mouldy, but it actually hasn't. But now I know it [food] tastes better before that [best before]." The students included almost all the common food items which are wasted, in their responses. One of the students said "eggs, meat, carrots, bananas, apples, beef, meat, broccoli umm pretty much everything." These answers reflected the students' diverse learning during the various episodes in the intervention. The students' responses suggested that they were more aware about the types of foods that are rejected, discarded, wasted or not picked up by the people which ultimately leads to their waste.

6.2.1.5 Students' knowledge about the end point in the journey of food waste

To probe the students' awareness about the end point in the journey of food waste, there was an open-ended question in the questionnaire. It was, "Where does unused food finally end up?" (See Q.7 in Appendix B). Before the intervention, the students' responses were very varied. The students had no particular place in mind and most of them wrote that unused food finally ends up in various places in our environment like in the rubbish, in the sea, in the ground and in the compost. Only one (1/19) student had written that unused food lands up in landfills. After the intervention, all except one student (18/19) wrote that unused food ends up in landfills. Most of them also wrote that leachate from food waste in landfills, ends up affecting the

surrounding air and the nearby water sources. The students could support their answers with reasons. They could write about the impact of food waste which is dumped in landfills. One of the students wrote, “the food ends up in landfills which is bad because it adds chemicals to our planet.” Another student wrote, “unused food ends up in the landfills causing bad gas in the atmosphere.” The students sounded more aware about the association that peoples’ food habits are also contributing to global warming.

6.2.1.6 Students’ knowledge about the amount of food waste

In my class observations during the teaching-learning episodes 1 and 3, I witnessed the students’ amazement and unhappiness when they became aware of the amount of food waste in their classroom, around the world, and in New Zealand. The students were shocked to look at the amount of food waste in their own class in one day, after the class food waste audit. One student said, “this [quantity of food waste] is happening in just our class, wow!” The students were curious to know more about food waste happening around the world. Other students asked questions like, “is it [food waste quantity] the world average?” and “which is the most wasted food item?” By the end of the third teaching-learning episode, the students seemed much more knowledgeable about the amount of food waste which takes place in their school, in New Zealand, and globally.

In order to find out about the impact of the various teaching-learning episodes on the students’ knowledge, and to understand the reason behind the individual students’ selecting the various activities, the following question was asked in the PoFGI, “What was the most surprising learning about food waste that you would like your family and friends to know about?” I found that the students were surprised to learn about most of the aspects of food waste which they were exposed to during the intervention. The students’ responses had a wide range including the quantity of food waste, effect of food waste on the environment, waste of resources and also managing food waste. A majority of the students were most surprised by the quantity of food wasted. One of the students responded “It [food waste] has grown so much in the past years” while another said, “how much we waste.” The students were surprised to know that bread is one of the most common food items to be wasted. One of the students said, “how much loaves of bread is wasted per year, over 2 billion loaves!” Some students wanted other people to understand the amount of food waste. One of them said, “I want to show people how much

food we actually waste each year like in our house and the world.” and another said, “I want them to know that how much of perfect food gets wasted for no reason.” The students also wanted other people to know about the environmental impact of food waste and said, “in the end what it [food waste] becomes and how deadly it is.” The other students said, “how much effect it [food waste] has on living things and all” and “food waste actually does affect our environment and food waste is like one of the worst things happening to our Earth.” One of the students was most amazed to learn about food miles and wanted other people to learn about it and its impact on the environment. He said, “how much the food actually travels.” The students were also keen that other people should learn about the waste of resources which too are wasted along with food waste. They said, “how much gas and oil are going into the ocean” and “how much hard work is put into the food that we are eating, and it is getting thrown away.” The students said that wastage of resources was one of the most surprising learning. One of the students said, “how much work goes into preparing the meals and what you eat.” The other students said, “how much money we actually waste, because we waste like billions of dollars each year on food waste” and “how much resources we are wasting by throwing away the food.” The students were also keen that other people should learn about reducing and recycling food waste. One of the students responded, “but if we don’t need it [food] then just don’t get it” while another said, “I would want to teach them [people] about composting food waste because I am not going to lie because we do waste food.” The students were also surprised to know that sometimes people do not buy imperfect looking fruit and vegetables. One student said, “how much fruit and vegetables are being wasted because they [people] are like- aww that looks imperfect” Another student responded, “how people are like- aww that doesn’t look cool, let’s throw it away” while another said, “no one will buy that because it doesn’t look right even though it tastes perfectly fine.” All these responses demonstrated the level of post- Intervention awareness among the students. The students had spoken about many facets of food waste which had surprised them, and they wanted to pass it on to others. The students’ responses indicated that they were thinking about reducing, reusing and recycling food waste.

6.2.1.7 Summary of students’ knowledge about food waste

In this section, I have presented findings about the students’ knowledge component of Food Waste Literacy before and after the intervention. After the intervention, the students seemed to be more aware about what constitutes food waste and its different aspects. Students were concerned about the amount of food waste and its impact on the environment. They were more

knowledgeable about the waste of resources which are also wasted every time that food is wasted. They wanted to address the issue of food waste and pass on their learning to their friends and family. They were keen to know more about food labels and food miles. They gave suggestions about reducing and recycling food waste and wanted to implement these ideas in their own homes. There seemed to be a greater awareness among the students about the big picture of food waste.

6.2.3 Students' attitudes and values about food waste

Attitudes and values about food waste make an important component of Food Waste Literacy as our attitudes and values influence our thoughts, words, and actions towards food waste. Positive attitudes and values towards food waste can create a food-secure future. Therefore, the questionnaire had three questions to specifically probe the students' attitudes and values towards food waste. They were questions 1, 2 and 3 in the questionnaire. Data about these components were also obtained from Post-Intervention Focus Group Interviews (PoFGI) and these are also reported here.

6.2.3.1 Students' attitudes and values about leftover food on special occasions

The initial question to probe the students' attitudes and values towards food waste was question 1 in the questionnaire. It was about what would the student like to do with the leftover food on celebration/special occasions with family/whanau at home. This question was important as the students had to think and decide amongst the various options, based on their attitudes and values towards leftover food. The post-intervention data for this question is shown in Table 6.5 which presents the number of responses, the means, the medians, and the standard deviations for three items alongside the same data from the pre-intervention questionnaire.

Table 6.5 Students' attitudes and values about leftover food (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
Pre-Intervention (Q.1)							
If my family/whanau had a celebration I would like to-	2	9	6	2	2.42	2	0.84
a) share any leftover food with the guests.							
b) pack any leftover food in the fridge to eat the next day.	9	9	1	0	1.58	2	0.61
c) throw the food in the rubbish bin.	0	1	4	14	3.68	4	0.58
Post-Intervention (Q.1)							
If my family/whanau had a celebration I would like to-	0	15	3	1	2.26	2	0.56
a) share any leftover food with the guests.							
b) pack any leftover food in the fridge to eat the next day.	9	10	0	0	1.63	2	0.50
c) throw the food in the rubbish bin.	0	0	1	18	3.89	4	0.32

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

There was a positive shift in the students' responses towards agreeing, that they would like to share leftover food with family and friends. The students' agreement with options that suggested better utilisation of leftover food, was seen with a low deviation in these positions. After the intervention there was a little more agreement with the idea of sharing food with the guests as the responses in agreement rose from 11 to 15. Post-Intervention, the number of students who were not sure about sharing leftover food and did not agree with the idea of sharing the leftover food also decreased from eight to four indicating a positive change towards the students' values of sharing food. During the class observation in teaching-learning episode 13, which was a 'talk' by a local food rescue volunteer, it was observed that the students were almost shocked to see the quantity of food waste, by just one supermarket in the town. The students asked many relevant questions like, "How much food do you rescue?" and "Is it [food] always so much amount which is given away by the supermarket?"

There was a slight shift seen in the choice of the students from 17 to 19 students after the intervention regarding packing the leftover food and eating the next day. The number of students who were unsure about exercising this choice with the leftover food came down from one to zero.

A shift was also seen in the students not agreeing to the idea of throwing the leftover food in the rubbish bin. The number of students not agreeing with the option of throwing the leftover food in the bin, before the class intervention was 14. This number climbed to 18 after the intervention suggesting a positive change in the students' attitudes and values around the leftover food. Another appreciable change was seen in the number of students, who were not sure about exercising this choice. Only four students were not sure about throwing the leftover food in the rubbish bin, before the intervention. This number came down to just one after the intervention. Before the class intervention, only one student was agreeing to the idea of throwing leftover food in the rubbish bin. However, after the intervention none of the participants were agreeing to that idea.

I also made an observation that most of the students were not aware of the cost of day-to-day food items. This observation was made during the class observation of the teaching-learning episode 11, which was about food budgeting. Most of the students were startled to see the prices of the various brands of bread, cereal etc. The students started exploring the websites of the different supermarkets in New Zealand, for cheaper options as they discussed amongst themselves that they were spending their hard-earned money. It was good to see that the students were being conscientious about their virtual money. One student said, "look this mincemeat is so expensive, why?" while another said, "thank you Deepa. Now I know how much food costs."

6.2.3.2 Students' attitudes and values about food getting wasted

Students' attitudes and values about food waste were further probed using questions 2 and 3 in the questionnaire. These questions were about the food given to people which they do not want to eat and people buying too much food for themselves. These two questions probed the students' attitudes and values about these two different aspects towards food which gets wasted

as a result. The post-intervention data for this question is shown in Table 6.6 which presents the number of responses, the means, the medians, and the standard deviations for three items alongside the same data from the pre-intervention questionnaire.

Table 6.6 Students' attitudes and values about food which people don't want to eat, and about overbuying of food by people (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
Pre-Intervention Q.2							
If people are given food which they don't want to eat, I don't think they have to eat it.	4	7	6	2	2.32	2	0.95
Post-Intervention Q.2							
If people are given food which they don't want to eat, I don't think they have to eat it.	0	5	12	2	2.84	3	0.60
Pre-Intervention Q.3							
I think that people buy too much food for themselves.	1	6	9	3	2.74	3	0.81
Post-Intervention Q.3							
I think that people buy too much food for themselves.	6	12	1	0	1.79	2	0.63

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

There was a shift in the students' responses towards an agreement about food which people do not want to eat. The biggest shift in the responses was seen in the choice of agreeing a lot with not eating food which people do not like. Before the intervention, there were four learners who agreed a lot to this option, while after the intervention, it came down to zero. It might indicate that the learners chose 'eating food which people don't want to eat' after the intervention, as they could realize the connection between not eating that food and that food getting wasted ultimately. This was potentially a constructive change in the students' attitudes and values about food choice. Another desirable change was seen in the response for 'agreeing to not eating food' which people don't like. This response came down to five from seven after the intervention. In all, 11 of the learners had agreed to varying degrees about people not eating food they don't like. But after the intervention only five of the students thought that people don't have to eat food which they don't like.

There was a shift seen in the students' responses towards agreeing that people buy too much food for themselves. The shift represented a change from some certainty and agreement to strong agreement, with a low deviation in this position. Before the intervention, only some students (7/19) were agreeing to the idea of people overbuying food. But after the intervention, almost all the students (18/19) had 'agreed' to overbuying as one of the reasons. The number of responses came down from nine to one, for 'not being sure' about people overbuying food. After the intervention, there were no learners who disagreed with people buying too much food, in contrast to three respondents who did not agree in the pre-intervention survey. The students could relate that people overbuy food, which is on sales and promotions, which leads to bulk buying and ultimately the food getting spoiled before it can be used. They seemed to realize the connection between the attitude of overbuying, which can lead to food waste and ultimately affects the sustainability of our resources.

There were an additional five questions in the Post-Intervention Focus Group Interview (PoFGI) to probe the attitudes and values aspect of the Food Waste Literacy of the students. In response to Q.4 (see Appendix F) "Why do you think people waste food?" the students' responses reflected the attitudes and values associated with wasting food. The students' responses had a wide range of reasons for people wasting food, which might indicate that the students could make connections with the learning which took place during the teaching-learning episodes. The students could synthesise their definite and explicit responses to the question and provided many reasons for people wasting food. Some students could voice that people waste food as they are selective or 'picky' in their food choices which results in those food items being wasted. One student said, "because they [people] don't like it [food]. Because they are picky." While another student explained, "because some people are picky, and they don't want to eat it. Like some breads, some meat and some vegetables which they don't want to eat." Most of the students felt that the physical appearance of fruit and vegetables is a key factor for them to be accepted or discarded, both at the producer and the consumer level. The students could also support their responses with their personal attitudes and values. Moreover, the students could also respond that people waste food due to their habit of overbuying which in turn leads to stored food not looking appealing after some time. One student said, "because they can't eat it all." While another student said, "... not looking as good as when they bought it." There was an awareness that people also waste food because of less willingness to find and understand food labels on the food products. One student said, "because they think that after

‘best by’ date, they can’t eat it anymore.” Another student said, “they [people] don’t understand food labels. So, they are going to look at it [food] and think ‘aww it has gone bad’ and they will throw it out. And they don’t know the difference between ‘best before’ and ‘use by.’” So, the students gave different responses based on their understanding about the reasons for food being wasted by people. These indicated better informed responses about food waste from the students, which signaled growing food citizenship (Gómez-Benito & Lozano, 2014) and Food Waste Literacy.

The students’ attitudes and values towards food waste was further probed by using the following question in the PoFGI, ‘How do you think about people wasting food?’ (Q.5 in Appendix F). The students’ responses were varied. They felt that people should actually think about the effect of food waste on the environment. One of them said, “they [people] should start thinking about the facts and how much it [food waste] hurts the earth and us.” Another one said, “I don’t think it [wasting food] is right, it harms our environment, people probably didn’t use to, but we should be able to live with not wasting food.” One more student thought similarly and responded, “I think it is just bad as it is causing environmental pollution.” Some of the students thought that they feel sad about people wasting food as one of them said, “I just feel like really sad.” The students could empathize with the less fortunate people in the world and on the one hand, think of all the wasted food and food scarcity on the other. They said, “if you think of all the poor people in the world then they would be just grateful for any kind of food, and we are just chucking it out.” Furthermore, the students thought that people who waste food are wasting many resources including money. One student thought, “how much money we end up wasting at the end of the day.” While another thought, “I think that people are just wasting their money to buy food which they just throw out later.” The students could connect-the-dots as one of them said, “they [people] are pretty much spending their money to make greenhouse gases.” Altogether, the students could connect and synthesize the various elements of food waste and could think about unhappiness associated with food waste, economic loss, direct and indirect environmental consequences associated with food waste, and wasting the resources.

To further assess the students’ attitudes and values towards food waste, another question that was posed to them in the Post-Intervention Focus Group Interview (PoFGI) was, ‘do you think

wasting food is a problem? why?" (Q.6 in Appendix F). The students' responses indicated that they were concerned about the humanitarian need for food, environmental and economic impact of food waste, and the wastage of natural and man-made resources. The students could connect food waste with hunger around the world. One of the students said, "we are throwing food that somebody living in poverty could have eaten." Most of them could think of the environmental impact of food waste, for example, they said, "yes, I think, it is a very big problem for the environment because most of it ends up in the landfills and it creates methane and leachate" and "yes, because it causes way too much methane which goes into greenhouse gases which causes global warming." A few of the students were able to extrapolate the impact of food waste on our planet. They said, "I think it is the most likely reason that our Earth will eventually become somewhere we can't live because of our food waste" (PoFGI, 3) and "I reckon that all the food waste and greenhouse gases that we are causing is similar to when we have temperature, we heat up and we might blow up or something. I reckon that is going to happen to Earth if we keep on wasting food." One student could see the added burden of food waste on the planet and said, "It is creating gases, spoiling our environment, causing global warming, methane, sea levels are rising and stuff, creating the world hot, contributing to strain the world really." The students could also relate food waste with waste of resources. This was voiced by one student as "lots of people put in so much effort to transfer and make food and we are not being grateful for that." Each student's responses might have reflected his or her personal attitudes and values about why wasting food is a problem. Their responses were unique as they were formed with the inputs and the processes involved during the intervention. The responses indicated a growing awareness about the connection between the ultimate phenomenon of food waste and the actual beginning of food waste by scraping of one's plate into the rubbish bin.

To further probe any change in the students' attitudes and values towards food waste, they were asked, "Do you think it's important to think and talk about food waste?" in the Post-Intervention Focus Group Interview (PoFGI) (Q.7 in Appendix F). The students' responses were filled with concern for spreading the knowledge about the importance and impact of food waste amongst the people. One student said, "because the more you spread the word the more people will realize how big the actual issue is." Another student said, "if we tell everyone, it can like create a kind of chain reaction of people making a difference that could help us find a solution." Most of the students felt that a majority of the people are not aware about the

significance and the impact of food waste. One student said, “because some people are like ‘aww food waste, it’s not that big’ when the actual fact is that it is one of the biggest problems in the world.” One student could relate the importance of food waste with the introductory class activity where the students discovered the average food waste in their classroom. He said, “if the average school child wastes here around 6 kgs. If only let’s say 10 people know about it then you are only reducing 60 kgs but say if 1000 people know about it, you are reducing 6000 kgs.” Students could think about the need of reducing and recycling food waste. It was important to talk about food waste to other people as one student said, “how people [food waste volunteers] are taking food [donations from supermarkets etc.] and giving it to people like ‘Love Soup’ [local food rescue organization].” Some students were thinking of finding solutions to food waste because of likely changes in their attitudes and values towards it. As, one student said, “because if you spread the word, it will go around and then everybody will start caring about it [food waste] and try and fix the problem. And try and find a solution to this [food waste].” They sounded interested and concerned about the issue of food waste. They talked of food waste being a problem which needed attention. This conveyed an increased sense of being an active food consumer and not just a passive consumer. In a nutshell, the students responses pointed in the direction which indicated that thinking and talking about food waste is essential. Even though each student might have assigned different reasons for thinking and talking about food waste, they all considered it important.

To have an insight into any change in students’ attitudes and values towards food waste, in the PoFGI, the students were also asked, “What have you learnt about food waste after this Unit that you would like other children to know?” (Q.12 in Appendix F). This question was expected to elicit responses from the students that would indicate their specific learning about the entire intervention which might have affected their attitudes and values in some way. The students’ responses had a wide range extending from the quantity of food being wasted to preventing and reducing food waste. The first and the foremost learning that the students wanted to share with other children was the global environmental impact of food waste. They were concerned about the ill-effects of food waste on the environment, as one student said, “I would like them [other children] to know how much damage has already been done even before we bought it [food]. So, if you are going to buy it, it has already done a whole lot of damage [because of pollution during transportation] and if you waste it you have done even more damage.” One student could relate the quantity of food waste going into landfills and the greenhouse gases

being generated by that. He said, “because the more food goes into the landfill, the more methane goes out as a greenhouse gas.” The students also wanted to pass on to the other children that wasting food is in fact wasting our resources. As one student said, “I would like other children to know that wasting food also leads to wasting other things like resources, time, energy, and money.” They also wanted to specifically share about the economic loss as a result of food waste. One of them said, “how much money is wasted in wasting food” while another said, “that our mums and dads work hard earning money and then we just waste it because we don’t eat our food.”

The students wanted to share the learning that there is nothing wrong with imperfect looking fruit and vegetables and they should not be rejected. As, one student said, “the imperfect food is not imperfect. It just looks funny. It is still edible.” The students were keen to share about the importance of reducing food waste and exploring the ways to do that. They wanted more people to become aware about the various aspects of food waste. One of the students said, “learning about how much we waste, how much resources and money we are wasting.” While another student said, “if more people could know what [the sample class] knows about it [food waste] then food waste will stop being a big thing. Everyone will eat their stuff.”

The students’ responses indicated that they wanted to share a lot with others, about their understanding and seemingly changed attitudes and values for food waste. They wanted other people to learn about the amount of food waste occurring in households, reasons for food waste, social, economic, and environmental impacts of food waste and ways of reducing food waste.

To gain an insight into any change in the value system of the students about food waste, after the intervention, the students were further probed with, “Which activities did you like to learn about food waste and why?” (See Q.11 in Appendix F). Here I present the responses, which I feel might indicate their developing attitudes and values towards food waste. Some students liked to learn about the amount of food being wasted. As one student said, “I liked the world data because it helped me know how much it [food waste] happens.” A few students liked learning about the environmental impact of food waste. One student liked the connection between food waste and global warming leading to the rise in sea water levels and submergence

of low-lying areas. He said, “the effect on environment and on New Zealand because it really helped me understand that if Fiji gets submerged then it affects New Zealand also [more people seeking shelter and refuge in NZ].” Students liked the activities where they had to find the cost of day-to-day food items, through virtual online shopping. They could relate with how the parents have to juggle the buying of everyday food items. One student said, “I also liked the one where we did online shopping. That was fun because we got to see what our parents go through when they go shopping.”

Moreover, most of the students liked the activities where they came to know about the journey of food from farm to table. Most of them were unsure before the activities and could connect with this new knowledge. As one student said, “the one I liked most was the ‘journey from farm to table’ because it showed us how far it came and how easily we can just throw it away.” And another student said, “I also enjoyed the videos and learnt a lot about where the food comes from, how it’s made, how it’s transported.” Students also found the ‘imperfect fruit and vegetables’ as the new ‘perfect fruit and vegetables.’ One student responded, “I liked the ‘imperfect food’ lesson because it showed how perfectly good food can grow naturally but looking different and we don’t have to throw it just because it looks imperfect.” Some students liked the activity around food rescue work and meeting the food rescue worker. They said, “my favorite activity was when the local food rescue worker came because he is actually helping people with food who cannot afford” and “I also liked when that food waste guy came here, and I learnt what he does and why he does it.”

6.2.3.3 Summary of students’ attitudes and values about food waste

In this section, I have presented the students’ attitudes and values towards food waste as a part of their developing Food Waste Literacy after the class-intervention was over. It was observed that the students had a shift towards a better handling of leftover food. They were keener to share the leftover food with other people. Most of the students agreed to the response that people buy much more food than they need which ultimately leads to some of that food being wasted. The students could describe in their own words the common reasons for food getting wasted by the people. Almost all the students voiced their disagreement over people wasting food and supported their reasons with appropriate examples. Most of the students could provide a positive response to the question, “did they think that wasting food is a problem and why is

it a problem.” The students gave noticeably clear and confident views in response to the question where they were asked if it was important to think and talk to more people about food waste. The students also expressed specific learning about food waste which they were keen to share with others and wanted more people to learn about. Overall, there was a positive change towards becoming active food consumers as a part of developing into better food citizens, and able to make food related decisions (O’Kane, 2016).

6.2.5 Students’ behaviour towards food waste

Behaviour towards food waste is an important component of Food Waste Literacy. Therefore, the questionnaire had questions which probed the students’ behaviour towards food waste. In the questionnaire, the questions which dealt with this aspect were questions 5, 12, 14 and 15. Data about the behaviour component were also obtained from the Post-Intervention Focus Group Interview (PoFGI).

6.2.5.1 Students’ behaviour towards the food given to them

The baseline question to evaluate the students’ behaviour towards food given to them was, “I try to eat all the food given to me” (see Q.5 in Appendix F). The students were given a flexibility in that question about eating all the food, by including the word ‘try.’ The post-intervention data for the question are shown in Table 6.7, which presents the number of responses, the means, the medians, and the standard deviations for the item alongside the same data from the pre-intervention questionnaire.

Table 6.7 Students’ behaviour towards food given to them (n=19)

	Agree a lot	Agree	Not sure	Don’t agree	Mean	Median	Std. Deviation
Pre-Intervention Q.5							
I try to eat all the food given to me.	2	7	9	1	1.79	2	0.79
Post-Intervention Q.5							
I try to eat all the food given to me.	10	9	0	0	1.47	1	0.51

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don’t agree = 4

There was a remarkable positive shift in the students' responses towards an 'agreement' for eating all the food given to them. The shift represented a change from some agreement to complete agreement, with a low deviation in this position. Before the intervention, there were 9/19 students who had agreed completely or agreed to some extent to the response that they try to eat all the food given to them. After the intervention, all the 19 students had agreed with this response which indicated a positive change in the students' reported behaviour towards their food. Also, after the intervention, the number of students who were not sure about this behaviour dropped from 9/19 to zero. The students could probably connect that the global food waste issue starts with the individual's or consumer's behaviour.

6.2.5.2 Students' behaviour towards imperfect looking fruit and vegetables

I also felt that it was important to probe the students' behaviour around buying imperfect looking fruit and vegetables and it was explored using a question (see Q.12 in Appendix F). The post-intervention data for the question are shown in Table 6.8, which presents the number of responses, the means, the medians, and the standard deviations for the item alongside the same data from the pre-intervention questionnaire.

Table 6.8 Students' behaviour towards imperfect looking fruit and vegetables (n=19)

	Agree a lot	Agree	Not sure	Don't agree	Mean	Median	Std. Deviation
Pre-Intervention Q.12							
I would buy fruit and vegetables that are not perfect looking.	0	9	7	3	2.68	3	0.75
Post-Intervention Q.12							
I would buy fruit and vegetables that are not perfect looking.	8	9	2	0	1.68	2	0.67

Note. Options Value. Agree a lot = 1, Agree = 2, Not sure = 3, Don't agree = 4

There was a shift seen in the students' responses towards agreeing that, if given the option, they would buy imperfect looking fruit and vegetables. The shift represented a change from some agreement and uncertainty to complete and strong agreement, with a low deviation in this

position. Before the class intervention, there was not a single student who made a choice to buy imperfect looking fruit and vegetables. Remarkably, after the intervention, most of the students (17/19) agreed to buying imperfect looking fruit and vegetables. In the class observation of teaching-learning episode 9 which was planned around the goodness of imperfect looking fruit and vegetables, it was seen that the students were fascinated by the real samples of twisted radish, bifurcated carrot, eggplant with knobs, conjoint tomato, twisted kumara and dimpled apples. Most of the students had never seen such unusual shapes of fruit and vegetables and were asking questions like, “Does imperfect one taste the same as the perfect one?” The responses indicated that the students were able to make connection with how food is grown in the fields and produced. They also seemed to show more gratitude towards imperfect produce. Students were asked to complete worksheets that probed their thinking about imperfect looking fruit and vegetables. Figure 6.2 shows one example (for more samples see Appendix N). In this worksheet, Amy had drawn a perfect looking and an imperfect looking strawberry. The thought and the act of drawing imperfect looking strawberry might convey her behaviour towards such fruit and vegetables, after the class intervention. Her response for choosing the funny looking fruit/vegetable communicates her understanding about the social impacts of food waste, which in turn affects food security for people.

Please draw any one fruit or vegetable of your choice.



Now please draw the same fruit or vegetable in its imperfect shape.



If you have a choice to buy, which fruits or vegetables would you buy- (tick one)
1. Perfect looking 2. Funny looking

Why? Can you give some reason?

Because they are completely healthy and edible and thousands of people starving from hunger would eat them, but we are just throwing them away.

Figure 6. 2 Amy's Worksheet

6.2.5.3 Students' behaviour towards leftover food

It was considered important to explore the students' behaviour towards leftover food outside the home and was probed by the question, "When I cannot finish my food at a fast-food place or some other place, I ask to get it packed and take it home." (See Q.14 in Appendix F). The post-intervention data for this question is shown in Table 6.9 which presents the number of responses, the means, the medians, and the standard deviations for the item alongside the same data from the pre-intervention questionnaire.

Table 6.9 Students' behaviour towards leftover food outside their homes (n=19)

	I rarely ask	I sometimes ask	I always ask	I always finish my food	Mean	Media n	Std. Deviation
Pre-Intervention							
Q.14							
When I cannot finish my food at a fast-food place or some other place, I ask to get it packed and take it home.	3	9	4	3	2.37	2	0.96
Post-Intervention							
Q.14	1	8	8	2	2.58	3	0.77
When I cannot finish my food at a fast-food place or some other place, I ask to get it packed and take it home.							

Note. Options value. I rarely ask = 1, I sometimes ask = 2, I always ask = 3, I always finish my food = 4

There was a slight shift in the students' responses towards asking for the leftover food to be packed and taken home. The shift represented a change from asking 'sometimes' to asking 'always' with a lower deviation in this position. Before the intervention, there were very few students (3/19) who 'rarely' asked for the leftover food to be packed to be taken home. Post-Intervention, this response dropped to just one (1/19) student. There was an increase in the choice of 'always' from 4/19 students to 8/19 students, after the class intervention. This reported behaviour indicated that the students might have internalised the behaviour towards leftover food and changed their everyday behaviour towards leftover food.

It was important to assess any changes in the students' behaviour about reducing food waste, after the class intervention was over, and therefore the following open-ended question was also asked- "What ways can you think that people can help to reduce food waste?" (See Q. 15 in Appendix F). Before the intervention, most of the students just wrote a few lines about the ways to reduce food waste while two students wrote just a line each. The students wrote about "giving the leftover food to the pet animals," "giving the leftover food to someone else" and

“just eating all the food.” In the post-survey, the students’ responses had a wider range, including all the 3 R’s (reduce, reuse, recycle) of food. Most of them had written five to six lines as compared to the pre-survey where they had written a few lines. The responses had an emphasis on preventing and reducing the food waste rather than recycling it. Some of the responses indicated a positive change in the students’ behaviour about food waste. They wrote about- stopping overbuying of food, cooking too much food, storing food properly, eating leftovers and composting food. In the class observation of the teaching-learning episode 12 where the students carried out an inquiry about preparing compost from food waste, it was observed that the students were very enthusiastic to learn about this option of recycling food waste. The students asked many questions like, “Why should we not put plastic, glass in composting?,” “Why shouldn’t we put meat in the compost bin?,” and “Doesn’t composting release methane gas?” (See Appendix N). There were four students who seemed very determined to set up a compost bin in their homes.

To assess any change in the students’ behaviour about reducing food waste, there were two questions in the PoFGI. They were asked “Can we do anything to stop food being wasted?” The students’ responses were very varied and suggested many behavioural changes. But the most common suggestion was about not overbuying food. One student said, “you shouldn’t overbuy because that is the main source of leftovers.” Two other students said, “when you go to supermarkets make a list so that you know what you need and just get that and not more” and “we can stop buying during specials’ bargains especially perishable ones because we may not eat it in time.” The other suggestions which were mentioned, also included ‘eating the leftover food.’ One student said, “start eating our leftovers or store them properly in the fridge and eat them tomorrow.” While another student said, “eat leftovers and reuse food that are perfectly fine.” The students also suggested that people need a better understanding of food labels to avoid food getting wasted. One student said, “we need to read the labels on our food, and we need to not throw out food that is perfectly good.” They also considered recycling of food waste. As one student said, “we can get compost bins.” The students’ responses had good suggestions about ways to reduce food waste. It might indicate that the students indeed had some reflection about all the learning which was taking place during the intervention. They were, perhaps, able to change their lived relationship with food and were embracing food better.

To probe any changes in the students' individual behaviour towards food waste, after the class intervention, they were also asked, "Do you see any changes in your food waste habits since the start of this Unit?" (See Q.9 in Appendix F). The students' responses included reported changes in their own behaviour and asking their families also to change their behaviour towards food waste. These reported behavioural changes may have been brought about by the learning which occurred during the various teaching-learning episodes. Most of the students responded that they had either stopped wasting food or were trying to stop wasting food. One student said, "when we are having breakfast, I have started eating crust of my toast. Like a few days ago there was a squishy apple and instead of chucking it away, I ate the whole thing." Another student said, "since we have been talking about it, I always had too much food left in my lunch box but now I am having less amount in my lunch box so that I actually eat everything in my lunch box." Some of the students said that they were trying to eat food which they did not like. One boy said, "umm I eat more of my food even which I don't really like, like broccoli. I got less picky." Some students responded that they had been discussing the topic of food waste with their families and working towards reducing food waste created by their families. As one student said, "I have told mum not to buy so much and we started cooking smaller portions." While another said, "I have told my family and we have tried to reduce it [food waste] by making a shopping list." Many students responded that they were discussing about the issue of food waste with their parents and family. One student said, "I have talked about it [food waste] to my parents and we have started thinking about it and how it affects the planet and why we were doing it." The reported responses signaled that the students had an overall positive behaviour towards food, its production and sustainability.

6.2.5.4 Summary of students' behaviour towards food waste

In this sub-section, I have presented data and analysis about the students' behaviour, after the intervention, as a part of their developing Food Waste Literacy. Most of the students agreed to eating all the food which is on their plate or packing smaller portions in their lunch boxes. The students also appeared to agree more to the option of getting packed, any leftover food if they are eating outside of their homes. They had many ideas to suggest towards reducing food waste and were eager to share them with their friends and family/whanau. However, the biggest shift could be seen in the students' personal food waste habits. Their reported behaviour suggested that many more students were conscious about not wasting food and were also thinking and

acting in ways which would reduce food waste. They seemed to be more inclined about taking better decisions and implementing effective choices with their food so that food is not wasted.

6.3 Teacher's Food Waste Literacy

6.3.1 Teacher's knowledge about food waste

The class teacher was also interviewed (see Appendix D) after the intervention was over, to explore how her knowledge component of Food Waste Literacy may have changed in response to the intervention. She was asked if her views about food waste had changed in response to the class intervention and she responded that indeed her views had changed. She said “now I know that how much impact it [food waste] has. I now know the number of resources, energy, and all of that, that is used. I now know more about the inside and industrial side of things and that really puts it all in a perspective, like the packaged foods are actually using resources which is bad in a way.” In response to the question, “do you think food waste is a problem in New Zealand also?” the class teacher commented “Oh yes, with the figures and everything it is a problem. And the fact that we learnt so much from this Unit is like a proof that it is a problem because we don’t know about it.” Before the intervention, the teacher had responded that she did not consider food waste as a big problem in New Zealand.

The class teacher was further asked, “were there any aspects of the learning which you found most surprising?” She answered that she had indeed gained more knowledge about food waste and observed that “yes, it was really surprising that the side learning to this thing [food waste] which fits this puzzle together, like the landfills are supposed to be covered so that it does not create leachate so that it does not go into the soil. Those kinds of things that you don’t really know. That kind of creates a more serious picture in our minds because then you are like ‘oh my gosh all this [food waste] is actually happening.’ So, there were quite a few surprising things.” After the intervention was over, the teacher was asked, “do you see any further opportunities in *The New Zealand Curriculum* for teaching and learning about food waste and its importance?.” She sounded positive about the intervention in creating Food Waste Literacy among the students. She said “definitely, and I think it [food waste] is important and I think all teachers should look towards covering because it is so prominent, and people don’t even think about it [food waste]. The meta cognitive thinking aligns very nicely with *The New Zealand*

Curriculum. So yes definitely.” The class teacher appeared optimistic about the inclusion of opportunities to learn about food waste in *The New Zealand Curriculum*.

In brief, after the intervention, the class teacher was more aware about the importance of food waste. She found certain dimensions of food waste very interesting and meaningful. She was keen for her students to develop into better food citizens. She was hopeful about ‘food waste’ finding the right space in *The New Zealand Curriculum*.

6.3.2 Teacher’s attitudes and values towards food waste

The class teacher was also interviewed after the intervention, to find out about her attitudes and values towards food waste as she was another stakeholder in the class intervention besides the students (see Appendix D). The class teacher’s attitudes and values seemed more positive after the intervention. She sounded even more concerned about the food waste issue, than she was at the beginning of the intervention. In reply to the question, “do you think you have any responsibility for engaging students to learn about food waste and why?” she said, “yes, I do, I am the teacher. They [the students] model after me. They need to see that I provide them the context of all the information, the impact and all that. You took that [food waste awareness intervention], you were here but if you were not there then it would have been my responsibility. It is quite important to learn about food waste because it is essential.” In response to another question, “what do you feel has been the learning from the professional perspective, being a part of this intervention?” she sounded positive about the intervention. To put it in her own words, “yes, I mean that this [the intervention] was a really good opportunity for the kids and for myself. I have learned a lot. It was really good to see because I got to take a step back. The fact that you actually teach them, and they actually start getting into it. They actually start acting on it and they are starting to build that knowledge of food waste. First they were like - ‘I know what it is’ but now they are like, I can have a conversation with them about ‘like what did you think about that article about food waste?’ They were talking about goats and how they can help prevent food waste.” The class teacher further confirmed her more positive attitudes towards food waste by commenting, “so, it was really good. I have learnt so much, and I have learnt how it can tie into so many different curriculums as well. I feel good about it.”

The class teacher sounded optimistic about the entire intervention process and found this a good opportunity to learn more about food waste. She seemed ready to adapt and integrate what she had learnt about this issue.

6.3.3 Teacher's behaviour towards food waste

The teacher was also asked after the intervention about any changes in her behaviour towards food waste. She was asked two questions which might indicate any change in her behaviour towards food waste. The first question was, “do you think you will continue to teach students about food waste? How might you do this?” The class teacher sounded positive about upholding her continuity about the importance of talking of reducing food waste. She said, “yes, I think they [the students] got a lot of knowledge from you and so once again if you were not here, I would do the same thing that you did to cover the global impact, the local impact and all of that. But then after this [class intervention] I think we would not do a full-on Unit like this because it is already covered but it will be through our daily conversations like what we [the class] notice about this [food waste]. Like one of the things, we can do by reducing the waste in our house. So basically, those kinds of daily conversations.” The next question was an extension of food waste activities beyond the teacher’s classroom. It was aimed at probing any change in the teacher’s behaviour regarding spreading the food waste awareness beyond her classroom. She was asked, “what further initiatives could be taken in the school about dealing with food waste?” The class teacher could think of some viable and good options for the school which could be an indication of her being more positive in her behaviour towards reducing food waste. In her pre-intervention interview, the teacher had suggested that food waste is not a big problem. But post-intervention, her response pointed out that she considered food waste is a big problem and should be tackled at school level too. Here is an excerpt from her response: - “there can be like- sharing the food, there can be donation boxes as long as they are not super processed allergic foods. They should not be pre-packaged foods. We [the school] have a school garden and we could potentially do a compost bin. And now that the kids know that it is not going to stink up the place, because if it stinks that means we have put too much water. So, we can definitely look at a compost bin as we have a big garden out here.”

I had also included four specific questions to probe the teacher and seek her feedback about the effectiveness of my intervention on the students. In response to the question “how do you think helping students to learn about food waste might contribute to their decision making about food

waste?” the teacher said that the students were talking to their parents about avoiding food waste. She said there was much less food waste in the class rubbish bin as compared to what used to be there before the class intervention. Here is an excerpt from her response: - “well if you look in the bin right now and compare it to term one and now [school term two], there is hardly any food scraps in there. They [the students] are already acting on it [the intervention]. They tell me that now they talk to their parents about it [food waste] and they say that they don’t pack the full lunch as they used to. And stuff like that. So, they are already acting upon on what they have learned. That bin by itself is just empty wrappers now.”

I was keen to explore the effectiveness of the activities in the intervention and to fathom that I asked the class teacher “do you think the activities were adequate and appropriate for the students’ learning? The class teacher responded that the activities became more suited for the students once the activities involved all the students using their Chrome-books for learning in some or the other way. Her response was, “yes. I think so. There are only like a few things that I would change just because it is an extension class (an accelerated class with over achievers) and a Chrome-book classroom. But at the end you got the kids to actually do the Chrome-book activities, so I mean they were very adequate and appropriate. And I think, it is ready for the teachers to pick up. And I think, it is quite good as long as those videos are still available.”

I was interested to know which specific activities were better for developing the students’ Food Waste Literacy and thus inquired from the class teacher “which activities do you think worked the best for learning about food waste and why?” Her response to this question was essential in determining the worthiness of the activities which were planned for the intervention. She responded that most of the activities were good, but she also identified quite a few activities which were particularly good. This can be gauged in her response here, “let’s see. I think the ‘best by’ and ‘use by’ was really eye opening for them [the students]. That was really good. In fact, they even got to examine the packaging [of food items] which was really good. I think, the virtual online shopping was good. The food rescue volunteer presentation they loved, and they [the students] still talk about it. It means it had a big impact. Harmful impacts of food waste explained scientifically was incredibly good. Some of the logical boys were really into that. So, I mean that most of these activities are really really good. I would say that ‘use by,’

‘best by’ and ‘imperfect looking fruits and vegetables’ were really great. The students were like ‘oww’ and loved it.”

To gauge the class teacher’s views about the overall impact of the intervention on the students, I asked her “how do you think students in your class have responded to this topic? Do you think the students will be more aware about food waste and its related issues after this Unit?” The class teacher seemed excited about the entire intervention and conveyed positive feedback. She said that the students were more aware about not wasting food, at least in the classroom and were acting in a more responsible manner towards food. Here is an excerpt from her response:

- “yes. It is quite funny (aww). They [the students] are very aware now and they do use the words that you [me] have taught them. They are like ‘aww that is avoidable food waste.’ They are burning each other for that. You know it means that they are aware, and it is quite funny, but they are like ‘I am being like Deepa’ ‘I am on to you, don’t waste that.’ They are like if somebody is eating a sandwich and the other one tells him ‘I am being Deepa; I am on to you. You better eat your crust.’ So, it is like they all know now that food waste is important and should be kept in mind all the time.”

6.3 Chapter summary

This chapter presented the status of the Food Waste Literacy (FWL) of the students after the intervention was over. Post-Intervention, the students’ Food Waste Literacy was explored by the use of the questionnaire, Post-Intervention Focus Group Interview (PoFGI) and class observations. The post-intervention analysis pointed to the changes in Food Waste Literacy of the students which also indicated the changes in the students’ decision making about food waste. The Food Waste Literacy of the students and the teacher was probed under the aspects of knowledge, attitudes and values, and behaviour toward food waste. The students’ responses in the post questionnaire, PoFGI and the class observations indicated a better awareness about food waste. The students’ responses also signalled towards improved attitudes and values, and behaviour towards food waste which might imply an improved and developing Food Waste Literacy. Some of the students were able to take better decisions on various day-to-day food waste related issues. The students were able to decide and tell their parents/caregivers about the quantity of food to be given in the school lunch box so that there was no extra food which might need discarding. Some of the students decided to eat foods like bread crusts which they

used to discard earlier. They decided to spread the word about the importance of food waste amongst their friends and family. Above all, most of the students decided to adhere to a collective consciousness of reducing food waste in the class.

The students' skills of inquiry about the Food Waste Literacy were honed while carrying out the various activities in the intervention. By the end of the intervention, there were many students who were keen on exploring more ideas about reducing, reusing, and recycling of food waste. They wanted to be active food consumers who are involved in the decision making about buying food, rather than passive consumers. Many students wanted to learn more about setting up a compost bin in their homes. There were some students who wanted to visit the local landfill to see and understand it better. There was a growing sense of food citizenship, seen among the students. The students were eager to find out more about the social, ethical aspects and ecological impacts of food waste. Moreover, the students realized that they could also be a part of the solution to this global challenge by becoming more aware of it and connecting with this sustainability issue.

The class teacher was also interviewed as she was also a stakeholder in this intervention. Her involvement and learning in this intervention journey were crucial. Being a teacher, she had to further develop her Food Waste Literacy so that she could facilitate the development of the Food Waste Literacy in her students. Her responses suggested that she became more aware about the scale and impact of food waste and realized that food waste is an issue in New Zealand also. She responded that the implementation of this intervention provided a wide range of opportunities for her students to learn about food production, consumption and wastage. She expressed a strong desire towards spreading and sustaining awareness about food waste among her students and in the school. The next chapter focuses on the discussion, conclusions, and recommendations from this study.

Chapter 7

Discussion, conclusions, and recommendations

7.1 Chapter overview

This final chapter presents the discussion and conclusions of the research, some limitations, the implications of the conclusions, and recommendations for further research. This chapter focusses on the main findings from this study where I have used a case study strategy in a classroom using social constructivist theory within an interpretivism paradigm. My study was aimed at exploring and developing the Food Waste Literacy of intermediate level students in a New Zealand school who were aged between 11 to 13 years old. Specifically, this chapter focuses on the findings of Chapters Four, Five, and Six along with discussion of how these findings relate to current understandings about Environmental Literacy, Food Literacy and Food Waste Literacy in the literature. In Chapter Four, I have presented the findings of the pre-intervention status of the students' Food Waste Literacy. In Chapter Five, I have presented the planning and designing of the intervention for improving the students' Food Waste Literacy, and in Chapter Six, I have presented the findings of the post-intervention status of the students' Food Waste Literacy.

There have been a few studies published with regards to the inclusion and state of food literacy in school curricula, globally (Poelman et al., 2018; Ronto et al., 2017; Sumner, 2015; Thomas, 2011) and in New Zealand (Ware et al., 2017), but all these studies focused on the health and nutrition aspect of food literacy. None of these studies looked specifically at children's Food Waste Literacy. Food waste is a significant problem worldwide and in New Zealand, and it is therefore important to develop Food Waste Literacy in young people. Food Waste Literacy can be thought of as a component of Environmental Literacy, which focusses on the development of knowledge, attitudes and values, and behaviour towards food waste issue. This research was therefore designed to (1) explore the status of Food Waste Literacy of Year 7 students in a New Zealand school; (2) devise and implement an intervention to engage those students in developing their Food Waste Literacy; and (3) evaluate the impact of the intervention on students' decision making in Food Waste Literacy. To achieve these research aims, the study was carried out in three phases. The first phase was the pre-intervention phase where the students' and the class teacher's knowledge, attitudes and values, and reported behaviour towards food waste were explored using a survey questionnaire, and a focus group interview

with students and a teacher interview. In the second phase, an intervention was designed and carried out by me with the input and feedback from the class teacher, which consisted of a teaching and learning Food Waste Literacy Unit of 14 episodes. The third phase involved post-intervention evaluation of the students' and the class teacher's knowledge, attitudes and values, and reported behaviour towards food waste, which was an indication of their developing Food Waste Literacy.

7.2 Discussion

In this section my focus is on the main findings from Chapters Four, Five, and Six, in a way that relates to the literature on Environmental Literacy and Food Literacy. This section is structured according to the three research questions that guided my study as follows: -

1. What is the Food Waste Literacy of Year 7 students in a New Zealand school?
2. What kind of intervention might be designed and implemented to engage Year 7 students in developing Food Waste Literacy?
3. How does an intervention activate Year 7 students' inquiry and decision making in Food Waste Literacy?

7.2.1 What is the Food Waste Literacy of Year 7 students in a New Zealand school?

In this subsection I discuss my findings in relation to the students' and the class teacher's knowledge, attitudes and values, and reported behaviour towards food waste, as an indicator of their Food Waste Literacy. These findings indicated the status of the students' and the class teacher's existing Food Waste Literacy in relation to their knowledge, attitudes and values, and behaviour towards food waste. These findings helped me in designing an intervention to develop their Food Waste Literacy.

Overall, the students seemed to have low awareness about the environmental impact of food waste, places where food waste occurs, the loss of resources associated with food waste, and the reasons for food waste. The students appeared to be less aware of the environmental impact of food waste which ultimately ends up in landfills. These findings are consistent with the observation that households do not see environmental impacts of food as an important issue (Howard & Brichta, 2013; Richter, 2017). There are similarities between the level of knowledge of the students expressed in this study and those described by Richter (2017), where

consumers considered the issue of food waste more as a social problem and less as an environmental problem.

The students' knowledge of food waste appeared to be influenced by their experiences in their homes and other familiar environments such as restaurants and marae. Students were less sure about food waste happening on farms, supermarkets and during transportation. Food waste at farms and supermarkets was not seen as a problem by the students. This was argued by Richter (2017) as being reprehensible that people felt that it was socially acceptable to waste food at farms and supermarkets, and he felt that people may need more information on the issue of personal, social, and ecological consequences of wasting food.

Most of the students were not sure about food getting wasted due to overbuying, cooking too much food, not consuming the leftovers or lack of interpreting the food labels like 'use by' and 'best by.' It has been suggested that educating and informing students about shopping practices, as an opportunity to reduce household food waste, could also have an impact on food waste (Silvennoinen et al., 2014). In my study, the students were too young to likely make many decisions involving food purchases, however, they may be in a position to influence shopping involving food.

The students were less aware about the loss of resources associated with food waste. Some of the students were aware of the involvement of natural and man-made resources for producing food. However, the students were unclear about the linkage between food waste and loss of resources. All, except one student, seemed unaware of the association between food waste and economic loss, and loss of efforts put in by people. As recognising the causes and consequences of overuse of resources is an essential aspect of Environmental Literacy (Hollweg et al., 2011), I could see a role for education, which can impart knowledge of food waste as an effective tool in preventing food waste (Kowalewska & Kołłajtis-Dołowy, 2018).

There seemed to be a lack of awareness amongst the students about why some people waste food. This indicated an issue with the students' sense of responsibilities, duties, and obligations towards other people and the environment, as food citizens of the world (Gómez-Benito & Lozano, 2014). As food citizenship can be seen as an extension of general citizenship, the

students need to think, be aware, and act on issues concerning food waste (Gómez-Benito & Lozano, 2014). I considered it vital that students should know their role of active food citizenry in achieving a sustainable model of food production and consumption that takes care of people's true needs (Gómez-Benito & Lozano, 2014, p. 138).

The students' responses in relation to knowing and learning more about food waste, reflected that they considered it important to learn more about food waste. This was significant as it indicated that the students were keen to gain knowledge so that they could address food waste problems, how they happen and the possibilities to solve them, which are indicators of a developing action competence (Jensen & Schnack, 1997). Action competence focusses on the development of personal competence and agency, as well as collective competence and capacity (Hollweg et al., 2011, p. 3.14) which may be expressed as environmentally responsible behaviour. Research suggests that knowledge may not always lead to environmental action or the development of pro-environmental behaviour. However, knowledge is an important precondition for the development of competence leading to action and behavioural adjustments in relation to issues such as food waste (Jensen, 2002, p. 329). Moreover, environment-related knowledge may have many dimensions: - knowledge about the existence and scale of environmental problems which might create curiosity and concern, thereby creating the starting point for a willingness to act, knowledge about root causes of environmental problems, knowledge about strategies for change, and knowledge about alternatives and visions. Therefore, I decided to include different dimensions of knowledge about food waste, to develop action competence concerning food waste.

The students seemed to have a general uncertainty and disinterest in their attitudes towards leftover food and its consumption or distribution, which may also be a factor which can lead to food waste. I also observed that the students had an indifferent attitude towards throwing away food or not finishing food on their plates. However, there were a few students who were uncomfortable in discarding leftover food, and their attitude was similar to the attitude expressed by some of the research participants in a study described by Djekic et al (2019) where people felt guilty and had a bad conscience when they wasted food.

I observed that the students seemed undecided about finishing food on their plates and about how to handle the leftovers. They appeared unsure about getting the leftover food packed in doggy-bags and taking it home if they encountered such a situation while eating in a restaurant/eatery. The students were unsure about the various implications of not finishing their food at home, as some of the students justified this behaviour by passing that leftover food to their family members or giving it to their pets like pigs and chickens. The students could not visualise that food can be saved from turning into leftover food if care is taken about the size of the portion and the desire for eating that food. The students had their own subjective meaning of the concept of food getting wasted, which may have been negotiated socially and historically, as a part of their family or community. The idea (of food getting wasted), may not be simply imprinted on the students but is usually formed through interaction with others (Creswell & Poth, 2016b). Moreover, the students seemed to lack an awareness regarding the preserving and consuming of leftover food to eat at a later time. It could be due to food waste behaviours encountered at the students' homes, as also suggested in a study by Parizeau *et al.* (2015), that it is important to understand the factors that may influence food wasting behaviours at the household level, in order to create food waste management systems and policies to reduce waste. Similarly, I found that the students could not see much worth in getting the leftover food packed and taken home when eating in restaurants, takeaways, or any place outside their homes. These results confirm the findings of Fami *et al.* (2019), which emphasise the need to change behaviours through thoughtful consumption to reduce food waste. I felt that most of the students had no or very little idea of the notion of being food citizens of the world and making sustainable choices.

The students seemed indecisive and hesitant when asked about buying fruit and vegetables which are not perfect looking. Even though the students may not be in a position to make the purchases yet, what I found concerning was, that most of them would still not be keen to buy unusual looking fruit and vegetables. This outcome confirmed findings from a study which had also indicated that consumers try to avoid food with visual imperfections and easily decide to discard them (Aschemann-Witzel, 2016). This also pointed towards the idea that as food citizens, the students were lacking in their responsibilities and obligations towards producers and the environment, and also lacking in their thinking about the environmental, social, and economic implications of what they buy and eat (Wilkins, 2005). Some students could not offer any suggestions of how to improve people's behaviour to reduce food waste. I found that these

findings reflect those of Parizeau *et al.* (2015), who found that many respondents in their study could not provide any suggestions for reducing food waste at household levels.

Responses from the class teacher indicated that she seemed aware about the issue of food waste in general, but she mentioned that she did not consider it a big problem in New Zealand. The teacher may not have been aware that food waste has been a considerable issue for some time in New Zealand and that many organisations have been researching and collecting food waste data (Reynolds et al., 2016; Waste Not Consulting, 2015). The understanding of food waste could be considered an important element of Food Waste Literacy, within the bigger subset of Environmental Literacy, and literature has indicated that teachers, and their personal dispositions towards environmental issues, are key to the development of Environmental Literacy in their students. Unless a teacher possesses Environmental Literacy, they cannot effectively provide opportunities for their students to engage in activities to develop Environmental Literacy (Kidman & Casinader, 2019). Therefore, I suggested that the class teacher should always be present in the classroom during all the activities which were planned for the students. It was clear that the class teacher already had a positive attitude and positive values towards reducing food waste, as she had volunteered for her class to participate in my study. This was further confirmed by her readiness to give a specific schedule for my planned study and by her constant support throughout my activities in the classroom. The class teacher was always reinforcing positive behaviour towards food waste in the classroom. She also acknowledged that she always tried to be a role model for her students for positive behaviour towards food not getting wasted in the classroom.

The evidence from the pre-intervention study suggested that there was scope to develop Food Waste Literacy as a type of Environmental Literacy for these students. Environmental Literacy includes knowledge of environmental concepts and issues, and the appropriate attitude to apply such knowledge to make effective decisions on a range of environmental issues (Hollweg et al., 2011). In order to act effectively towards reduction of food waste, young people should have some knowledge of causes, and consequences of the issues at local, regional, and global levels. Moreover, as food literacy has no end point of competence and individuals may have a variable continuum of knowledge, skills, or behaviours within each of its four domains of planning and management, selection, preparation, and eating (Vidgen, 2016), it should

incorporate the dimension of food waste too. Individuals may also have different competency levels across these four domains of food literacy. These competencies levels may keep changing during the course of life indicating the dynamic nature of food literacy. Therefore, I reason that the domain of food waste could also be included to broaden the scope of food literacy. Recommendations have been made about improving food literacy with regard to reducing food waste (Aschemann-Witzel et al., 2020) including raising awareness on better food choices around buying, managing, and storing food. The students were not aware about the importance of food waste and its connected dimensions such as its causes, prevention and environmental, social and economic impacts. This was also highlighted in a study finding about middle schoolers in Poland (Kowalewska & Kołłajtis-Dołowy, 2018) suggesting that these students tend to waste food because of less awareness about the food waste issue. For these reasons, I considered that the students' knowledge, attitudes and values, and behaviour specifically around food waste might be advanced through an intervention. A combination of environmental knowledge, attitudes and values, and environmentally responsible behaviour are important to take effective actions and bring about change in a range of environmental contexts (Hollweg et al., 2011).

This could promote the students' Food Waste Literacy and help them to use food judiciously by acquiring the ability to use the food produced in the most sustainable ways, through consideration of the whole system from the production to the consumption of food. Developing Food Waste Literacy should assist in promoting the values of ecological sustainability, community and participation, and innovation, inquiry and curiosity in *The New Zealand Curriculum* (Ministry of Education, 2007). The inclusion of Food Waste Literacy across different learning areas will advance the vision of *The New Zealand Curriculum* of young people being actively involved in the social, economic and environmental well-being of New Zealand, being lifelong learners, making informed decisions to live full and satisfying lives, and mitigating the problem of food waste.

7.2.2 What kind of intervention might be designed and implemented to engage Year 7 students in developing Food Waste Literacy?

In this subsection I discuss my findings in relation to the intervention that I designed and implemented to develop the Food Waste Literacy of the students. The pre-intervention findings

had indicated that there was a potential gap between the existing Food Waste Literacy of the students and that which could possibly be achieved through teaching and learning about food waste. Erdogan (2015) had shown that students' environmental knowledge, environmental attitude and responsible environmental behaviour could significantly increase after a teaching and learning intervention. The effectiveness of an intervention in raising awareness of food waste as a problem and changing food waste behaviour had previously been shown using a pre-post design, enquiring about changes in self-reported food waste awareness, before and after the intervention (Soma et al., 2020).

Therefore, I decided to implement a food waste intervention with the students and their teacher. I chose an inquiry-based approach to underpin the intervention. Inquiry-based learning is one of the approaches suggested by *The New Zealand Curriculum* that encourages the development of action competence (Ministry of Education, 2020b). In addition, during the pre-intervention, there were positive indications of curiosity in this topic from the students and the teacher. The students were eager to learn about food waste because they had encountered the issue of food waste for the first time when they attempted the pre-survey questionnaire. They were inquisitive about this new context of food waste which may have connected with their experiences. Inquiry based learning may increase students' engagement in their learning experiences around food waste, and food waste may become more relevant to them.

Due to the classroom settings in which I was an external teacher and the limited time for the intervention made available to me by the class teacher, I settled on the use of Guided-Inquiry Learning (Kuhlthau et al., 2015) for the intervention as it provides a solid, research-based model for learning and has been found to be effective in classroom studies (Chu et al., 2011). I decided to use the Guided-Inquiry Learning, as it has also been found to be effective to develop skills such as the ability to apply knowledge and reasoning skills (Chu et al., 2011) which I considered extremely important to develop Food Waste Literacy in the students. Guided-Inquiry can engage, interest and challenge students, as well as motivate them to question, explore and make new ideas (Chu et al., 2011; Kuhlthau et al., 2015). Guided-Inquiry could promote critical thinking skills in the students when they make their food choices. They would be able to answer the question of making informed food choices for themselves with an understanding of food security, sustainability, environment, and ethical aspects of food waste.

The Intervention Unit had 14 teaching-learning episodes which were planned around developing the knowledge, attitudes and values, and behaviour components of Food Waste Literacy. The episodes were planned, keeping in view the suggestions from the literature review which indicated the importance of the various core elements of Food Waste Literacy. A class food waste audit was used as a hook to attract the students' attention towards the food waste problem which also engaged the students with the first core element on this study, which is developing knowledge about food waste. Knowledge about food waste will help in development of new practices to decrease waste, and students more likely to avoid food waste, as argued by Silvennoinen *et al.* (2014) and Principato *et al.* (2015). Mirosa *et al.* (2018) also suggested that increased awareness of the social, environmental, and economic implications of food waste is important before we can expect people to act to reduce food waste. The initial episodes of the Unit thus guided the students with the exploration of knowledge of food waste and its different aspects like its causes, scale, prevention, and environmental, social, and economic impacts. Exploring and developing attitudes and values, and behaviour about food waste are the other core elements, as highlighted in a study on food waste in foodservice organization by Goonan *et al.* (2014). The researchers found that food waste generation was influenced by the attitudes of foodservice personnel and that generating sustainable behaviour in the workforce could lead to more sustainability of the global food system. Findings from a study (Parizeau et al., 2015) about household food waste production and related beliefs, attitudes, and behaviour in Canada also indicated that food awareness can influence household behaviours. Therefore, the next few episodes provided the students an opportunity to explore their attitudes and values towards food waste, in the light of their knowledge. Some episodes then provided the students with exploration around behaviour that led to food waste. Experiencing and exploring the core elements of attitudes and values, and behaviour towards food waste may deepen the students' engagement with food and may transform them into better food citizens by making more informed decisions about food, including what they themselves could do about the problem at school or at home. The students might develop better relationships with food and advocate towards a more socially and economically just, and environmentally sustainable, food system (Meyer *et al.*, 2021).

Additionally, there can be alternative sequences of the core elements in the Unit that I followed in my study. For example, an alternative hook can be a recent unusual weather phenomenon, as a result of global warming. This can then lead to knowledge of causes of global warming, food waste being one of them. Other possible alternate hooks for engaging students to food

waste could be a focus on the International Day of Food Loss and Waste, food insecurity - locally and globally, food banks, food rescue organisations, environmental impacts of landfills, imperfect fruit and vegetables, food and green waste bins, composting etc. Teachers can alter the sequence of the core elements of this Unit according to the hook being used to engage students. For example, if the hook of food rescue is used, the students could be part of a food collection/donation event being carried out by a food rescue organisation. The students could inquire into reasons for food being rescued and that could lead to an inquiry about reasons for food being donated/discard/wasted. The classification of different reasons for food rescue could be inquired into by students in different sequences. For example, in one sequence, the initial focus could be towards developing the core element of knowledge about food waste. While in another sequence, the initial focus could be on exploring and developing the core elements of attitudes and values, and behaviour of people which leads to food waste.

The intervention Unit seemed to have worked in developing the students' Food Waste Literacy as the overall conditions were favourable for my study. The school was an Enviroschool, meaning that they were already experiencing education for sustainability ideas, and the school Principal and the class teacher were keen for the participation of their students in this study. It was an accelerated classroom where all the students had access to quick information as they all had chrome books (tablets) and received more learning inputs from their teachers. However, any teacher in New Zealand would be able to implement this intervention, using just the core concepts of the Unit, as mentioned above. Teachers could conduct guided inquiry about food waste as food is relevant to all children and because food waste happens everywhere. This Unit can be undertaken by the students at any Year level keeping in mind the composition of the students and the Learning Progression Frameworks of *The New Zealand Curriculum* (Ministry of Education, 2019b). The Unit could be further improved by including updated information about the core concepts of food waste as knowledge in the field of food waste is increasing rapidly in the world and in New Zealand. Teachers might use some other pedagogy like project-based learning or gamification to implement the Unit, for effective learning. Teachers in other countries might also use this intervention Unit by substituting local examples in place of examples from New Zealand and adapting the Unit according to their curriculum.

7.2.3 How does an intervention activate Year 7 students' inquiry and decision making in Food Waste Literacy?

This sub-section discusses the findings in relation to the students' knowledge, attitudes and values, and reported behaviour towards food waste as an indicator of their developing Food Waste Literacy, and their inquiry and decision-making regarding food waste after the intervention.

Overall, the students seemed to be much more aware about the social and environmental impacts of food waste, the usual reasons for food waste, places where it is wasted, the loss of resources associated with it, and the amount of food wasted. The students appeared to be more aware and mindful of the environmental impact of food waste which ultimately ends up in landfills. This finding broadly supports the work of Grodzinska-Jurczak *et al* (2003) linking an intervention programme with improvement in students' knowledge and awareness. This result was also consistent with that of other studies (Barr, 2007; Di Talia et al., 2019) which found that individuals with knowledge of the problems linked to food waste are more likely to avoid wasting food. However, in a U.S. study about the effect of classroom intervention on student food selection and plate waste, the intervention had no impact on the amount of fruit and vegetables wasted by students (Serebrennikov, Katare, Kirkham, & Schmitt, 2020). The study was though carried out on elementary school children to evaluate the effectiveness of a classroom nutrition education. The study might imply that inducing a behavioural change in elementary school students is a complex process and might need more than classroom lessons and a longer intervention period. Some of the students in my study were thinking of addressing food waste issues, with the recently acquired knowledge about the harmful impact of food waste on our environment. The students' responses suggested that they were keen to participate, actively and critically, in problem-solving and decision-making about food waste. It was an indicator of their developing Environmental Literacy wherein the students were beginning to view the environment as a resource which has to be managed and shared (Sauvé, 2005).. Further research into the critical understandings of food waste would be merited. Many students were able to articulate concern about the impact of food waste in general and on the environment in particular. I could see a growing sense of food citizenship developing in the students. The students had started thinking about the implications of how they eat their food, and that their food choice is also an issue of duties, responsibilities and obligations towards all people and the environment (Gómez-Benito & Lozano, 2014).

The students also had some alternative conceptions/misconceptions about food waste which were also addressed during the intervention. For example, the students had alternative conceptions about the amount of food waste and that it is not bad for our environment. The students watched videos about the amount of food waste and its harmful effects on the environment which prompted them to reason through their alternative conceptions (Galindo, 2022), which may have resulted in more lasting learning compared to when they were simply told the right answers. Therefore, students' alternative conceptions can be handled with student-centred, activity-based learning methods which enable students to take ownership of their learning (Galindo, 2022). Before the students embrace the correct concepts, they must confront their own beliefs and then attempt to reconstruct their knowledge (National Research Council, Division of Behavioral and Social Sciences and Education, Board on Science Education, & Committee on Undergraduate Science Education, 1997). Teachers must provide such opportunities to students in the form of inquiry-based activities or other minds-on experiences, and should help students in reconstructing and internalizing their knowledge (Gooding & Metz, 2011). The teacher has an important role to play here which requires them to first identify students' alternative conceptions, then provide a platform for students to confront their alternative conceptions and lastly, help students to internalize their knowledge. For example, some students had alternative conceptions about the goodness of imperfect looking fruit and vegetables. They believed that those foods were not as tasty or good. The students were helped in confronting their alternative conceptions by offering them a piece of the imperfect looking carrot and apple. Thus, teachers can ask students to give evidence to support their explanation. However, as alternative conceptions may be held deeply and strongly defended, teachers should not underestimate the importance and the persistence of these barriers to true understanding (National Research Council et al., 1997) of food waste.

After the intervention, the students appeared to be more knowledgeable about the reasons and places for food waste. The students seemed to be more aware of the concept of a Food Supply Chain and agreed more that food waste was taking place at the various stages of the Food Supply Chain, including households. The students were more aware about the usual reasons for food getting wasted. They had better understanding about the food labels, like 'use by' and 'best by,' overbuying of food, cooking more food than needed, not eating leftovers, and discriminatory buying of imperfect looking fruit and vegetables. The students seemed cognizant of the loss of resources which are associated with food waste as they were better informed about the usage of different resources at the different stages of food production. The

students had constructed varied meanings of food waste as a result of their social interaction with their classmates and their two teachers (class teacher and I), and their interpretation and understanding of the knowledge which was discovered through the Food Waste Literacy Unit (Adams, 2006). The students were now aware of concepts like ‘food miles’ and their responsibility to purchase locally produced foods which may help them to become good food citizens. They were more familiar with the amount of food being wasted at the different regional levels. As I completed my analysis, I made the observation that this intervention where the students analysed food waste, had increased the visibility and awareness of the students about the issue, and its consequences. This overall increase in awareness seemed like a positive strategy to combat food waste as was also suggested by Goonan *et al.* (2014). The internalisation of food waste knowledge seemed to have taken place through the social interactions between the students and that formed an integral part of learning about food waste. The teacher directed Guided-Inquiry Learning offered a ‘scaffolding’ to the students and assisted them in learning about food waste.

Post the intervention, the students reported a more positive attitude towards sharing leftover food and they were more inclined towards not throwing leftover food in rubbish bins. The students also felt that people who waste food buy too much food. They realised that some fruit and vegetables are wasted because they do not look perfect. The students’ reported a changed attitude which I could witness at the end of the episode where I had demonstrated some imperfect looking fruit and vegetables. All the fruit and vegetables were taken away by the students to be consumed at home. The students had a lot to offer to each other during such occasions where they were sharing their learning with other students. These moments provided good examples of social and cooperative learning taking place in a social constructivist classroom (Kalina & Powell, 2009). The students indicated that they considered food waste as a problem and people should talk about food waste. Some of the students decided that sharing their insights about food waste with more people would make a positive impact on people’s attitudes and values towards reducing food waste. There are similarities between the attitudes towards leftover food, as expressed by the students in this study and those described by Parizeau *et al* (2015). The students admitted that imperfect looking fruit and vegetables have the same qualities as their perfect looking counterparts, which was in line with a previous study (Xu *et al.*, 2021) which mentioned that consumers who were more aware about the connections between food waste and the environment had similar positive purchase behaviour.

After the intervention, the students reported taking better decisions regarding ways to reduce food waste, food on their plates, dealing with leftover food and their overall behaviour indicating less or no food waste. This reported behaviour of the students was similar to the findings of a short term awareness project by the World Wildlife Fund (WWF) in 46 schools in nine cities across the US in 2019 (WWF, 2019a) where the elementary schools reduced total food waste per student by about 53%. The students in my study reported that they were making better decisions while putting food on their plates so that they were able to finish their food. Some of the students decided to pack their own school lunch box so that they only packed the quantity of food which they would be able to finish. These findings were similar to those found regarding food waste responsibility in a study (Parizeau et al., 2015) where the respondents agreed that they can reduce the amount of food being wasted by being responsible for their meal sizes. However, these respondents were households and families. In my study, it is young people who were showing responsibility about food waste by deciding about the food portions, which is similar to a behavioural change intervention in Australian schools (Boulet et al., 2022a) which showed that students' involvement at home in choosing and/or preparing food to take to school, led to a reduction in avoidable food waste in schools. The students in my study also reported that they would get any leftover food packed if they were eating in a restaurant/eatery and take it along to be eaten later. The students reported that they had decided to be involved in the process of grocery purchase by their families, to avoid overbuying and to ensure that imperfect looking fruit and vegetables are not ignored. The students reported talking to their parents/families/whanau about ways to reduce food waste and why it is important. This was in contrast to a study of development of energy literacy in New Zealand children (Aguirre-Bielschowsky, Lawson, Stephenson, & Todd, 2017a). The study reported that the children were not influencing their families to conserve energy. The students in that study were younger (age 9-10) than those in my study and it is possible that they thought that energy was a complicated issue about which they could not talk to their parents. The students in my study had started showing their active interest in exercising their food choices which was an outcome of their improved knowledge of the production and distribution of food (Gómez-Benito & Lozano, 2014). While the students in the energy literacy study were reported to have low agency and did not intend to save energy to a further extent.

The overall findings of this food waste intervention, to develop the students' Food Waste Literacy and their inquiry and decision making around food waste, seem to be positive. This positive development in the students' inquiry and decision-making skills involving food waste

may turn into a long-term impact of this intervention, as indicated in an Australian school study (Nanayakkara et al., 2018) which also pointed out the importance of initiating food literacy education in secondary schools. The students seemed to be more aware about food waste, its importance, its causes, its prevention and ways to reduce it. The students appeared motivated to learn more about food waste and its implications which may have been as a result of the Guided-Inquiry Learning and an authentic learning environment being created during the teaching-learning episodes (Abdi, 2014; Aulls, 2008). The students' improved conceptual understanding (Kathy et al., 2010) about food waste could also be an outcome of the use of the Guided-Inquiry Learning in this study. The students' reported attitudes, values and behaviour towards food waste also indicated their developing Food Waste Literacy. The World Wildlife Fund (2019a) study had recommended conducting more formal experimentation of waste reducing interventions as an opportunity for food waste reduction and repurposing in schools. These recommendations resonate with my study. The students seemed to be more inclined towards reducing food waste at both personal level and family/whānau level. There were signs of students developing relationship with *oikos*, our common home, this living environment where humanity is connected with the more-than-human world (Sauvé, 2017). An example of the students' developing Food Waste Literacy was a moment in the classroom when I was not present (but was told about by the class teacher). A student tried putting a half-eaten apple in the class rubbish bin and this student was at once told off by another student with words "I am being Deepa (my name), do you think it is right to throw that half-eaten apple away?" This was also an example of social learning experience for all the students who witnessed this moment as it provided an opportunity to make sense of this newly acquired idea of food being wasted, in this situation. This moment was also an example of the students' social learning about food waste, in the classroom, which was taking place as a result of peer interaction (Wals, 2011). This social learning may have also contributed to the students becoming food citizens who are aware of 'sustainable food' and may have desirable changes in their attitudes and behaviour towards food waste.

The social interaction of the students amongst themselves, and with me and the class teacher appeared to have led to internalization of food waste knowledge. However, this internalization of food waste knowledge was expressed differently by different students, which was possibly due to their own individual experiences. These differences were discernible in the students' post-intervention responses.. The students appeared to be developing the skills of recognizing

food waste as part of our environment, which needs to be understood to improve the decision-making about food waste (Sauvé, 2005).

After the intervention, I also interviewed the class teacher and found that the class teacher seemed more informed about food waste issues, and the overall impact of food waste on our environment. She responded that she was not aware about food waste being such a substantial problem globally and in New Zealand too. She acknowledged that she was much more aware now about the environmental, social, and economic impacts of food waste, and that more learning opportunities about food waste should be created through The New Zealand Curriculum. The class teacher's attitudes and values about food waste seemed even more positive than at the beginning of the intervention. She felt that more students should learn about food waste. She admitted that after the intervention she could visualise herself making more food waste connections within various learning opportunities in the classroom. In the post-intervention interview, her reported behaviour indicated a more sustained effort from her to include food waste in everyday class discussions and planning and organising food waste ventures in the school. Being environmentally literate is much more than possessing associated knowledge and skills and a futures orientated disposition is also required (Kidman & Casinader, 2019). This multi-dimensional integrated structure of Environmental Literacy in the class teacher could be witnessed when she arranged for a special morning assembly presentation by her students, where the students' presented information about food waste through drama, posters, song, and using infographics. She also organised a special event for the students of the remaining Year 7 classes, and all Year 8 students, in which I had an interactive session with them. In this session which lasted over two hours, I shared the most important aspects of food waste with these students and their class teachers.

In this Guided-Inquiry Learning, both the class teacher and I were acting as facilitators and helping the students to arrive at their own understanding of the food waste content as outlined under the social constructivist approach (Adams, 2006). At the end of the intervention, the class teacher reported growth in her Environmental Literacy, and specifically Food Waste Literacy as a result of her being involved in the Guided-Inquiry Learning. This was a positive, associated outcome of this study which would supplement the teacher's Food Waste Literacy and enable her to develop corresponding literacy in her students, across different learning areas (Kidman & Casinader, 2019).

7.3 Conclusions of the study

Many studies have investigated the food literacy of individuals; however, the studies have most often focused on the knowledge, skills and behaviour related to health and nutrition awareness of individuals (Vidgen & Gallegos, 2014), planning and management, selection, preparation and eating of food (Vidgen, 2016), or a kind of intellectual capital which demonstrates significant impacts on individual and collective behavioural intentions (Palumbo, 2015). Food literacy has expanded as a multi-faceted term encompassing and examining the relationships between social, economic, and political aspects of food waste (Bellotti, 2010; Palumbo, 2015; Pendergast & Dewhurst, 2012), or better decisions involving food, and emotions involving food (Cullen et al., 2015; Truman et al., 2017; Vaitkeviciute et al., 2015). My study focused on the component of food waste under the definition of food literacy and my goal was to develop Food Waste Literacy and situate it alongside the broader notion of Environmental Literacy. This novel study adds to knowledge about young children's environmental learning by offering that specific knowledge, attitudes and values, and behaviour towards food waste and can be put together as 'Food Waste Literacy.' This may be developed in students by appropriate intervention and curriculum design. The study findings offer a comprehensive understanding of students' knowledge, attitudes and values, and behaviour before and after an intervention, to develop their Food Waste Literacy. This study adds to the role of Environmental Education in learning to relate to our individual and collective self in terms of food waste and to relate to our *oikos*, our shared house of life (Berryman & Sauvé, 2016). The practical and theoretical heritage of Environmental Education, focusing on our human relationship with and within *oikos* (Berryman & Sauvé, 2016), can contribute to managing the food waste problem. This study highlights the unique window of opportunity for the early adolescents for environmental awareness and connectedness (Blanchet-Cohen, 2008), and that children have a quest for understanding, but also a capacity to focus and an ability to transcend themselves (Scott, 2004). My study can guide other teachers to consider how young adolescents can be engaged to develop their environmental involvement, to build the foundations of a society of critically engaged and committed young citizens (Blanchet-Cohen, 2008, p. 270). The study contributes to the relevance of education in mitigating environmental problems like food waste. Specifically, my study indicates that early adolescence could be a window of opportunity for environmental connectedness. Moreover, the core concepts of the Unit can be sequenced and implemented by the teachers according to the particular settings and curriculum needs of the classroom, to develop the Food Waste Literacy of their students.

The conclusions drawn on the findings and discussion of this study, are presented below in relation to the research questions.

Research Question 1: What is the Food Waste Literacy of Year 7 students in a New Zealand school?

1. Evidence from this study shows that the students in this study had limited knowledge of the issue of food waste and the importance to be aware of it. They were not aware about the quantity of food waste taking place locally and globally. There was an uncertainty about the environmental impact of food waste amongst other associated impacts. They did not have a clarity about - the causes of food waste, understanding food labels, places where food waste takes place including households, and ways to reduce/prevent food waste. However, they appeared curious and willing to learn about food waste and the scale of the problem, and the scope of the *New Zealand Curriculum* demanded it.
2. Evidence from this study shows that some of the students' attitudes and values towards food waste were not positive. There was uncertainty in their attitudes towards leftover food and decisions regarding its handling. The students were not sure that overbuying of food may lead to food waste.
3. Evidence from this study shows that the students' reported behaviour towards food not getting wasted was not favourable. They were not mindful of leaving leftovers at home, getting leftovers packed for home or discarding them inappropriately. The students were not keen to buy imperfect looking fruit and vegetables if they ever had such an opportunity.

Research Question 2: What kind of intervention might be designed and implemented to engage Year 7 students in developing Food Waste Literacy?

1. Findings have supported the usefulness of intervention to develop students' Environmental Literacy (Pan & Hsu, 2020) and for behavioural change to reduce consumer food waste (Närvänen, Mesiranta, Mattila, & Heikkinen, 2020). The data from the pre-intervention survey and a review of the literature indicated that it might be productive to design and use a teacher directed Guided-Inquiry to develop the students' Food Waste Literacy. The data had indicated that there was a further capacity to develop the students' Food Waste Literacy, and a Guided-Inquiry would be appropriate for *The New Zealand Curriculum* and for what the literature says is useful and productive in developing environmental literacies. Teacher directed Guided-

Inquiry learning was an appropriate pedagogical approach to use, as I was not the students' classroom teacher and I had limited time with the students available to me. Teacher directed Guided-Inquiry, with an underpinning of a social constructivist view of learning influenced by Vygotsky (1978), could help the students make meaning about the concept of food waste through interactions with each other, their teachers and other socially-derived resources in their classroom environment. Using a social constructivist approach, the students could understand the concept and idea of food waste better, in the company of their peers and the two teachers (class teacher and I) (Woo & Reeves, 2007).

2. Evidence from this study suggested that the social constructivist approach could also enhance the students' action competence with reference to the issue of food waste and motivate students to become food citizens of the world. The students learnt about food waste through interactions with their classmates, their teachers, and the food rescue worker. The students were presented with various opportunities to obtain new knowledge or expand the knowledge they already possessed about food waste. The students could be more than conscious consumers by understanding the wide-reaching impact of their decisions about what and where to eat. The students could have agency over food waste and could empower others to develop food citizenship.
3. As environmentally responsible behaviour can be the expression of knowledge, attitudes and values, and competencies of individuals within a context, the students could acquire responsible food waste behaviour by acquiring knowledge about the food waste problem, how it arises, and what are the possibilities for solving this problem. The students' Food Waste Literacy may be developed which could contribute in lessening of food waste, as research suggests improving Food Literacy and raising awareness to reduce food waste may ultimately help in reducing food waste (Reynolds et al., 2020).
4. Therefore, the intervention design in this study would consider an appropriate theoretical framing, an appropriate pedagogical approach that fits with local curriculum and engages the students in learning about and addressing the environmental issue around the concept of food waste.

Research Question 3: How does an intervention activate Year 7 students' inquiry and decision making in Food Waste Literacy?

The intervention was aimed at developing the students' Food Waste Literacy through knowledge, attitudes and values, and behaviour aspects of food waste, and its impact, if any, on the students' inquiry and decision-making in food waste.

1. Evidence from this study shows that there was a positive shift in the students' knowledge about the issue of food waste. They were more knowledgeable about the various aspects of food waste - its scale at local, national and global levels, reasons for food waste, ways to reduce or prevent food waste, and its environmental, social and economic implications.
2. Evidence from this study suggests that there was a positive change in students' attitudes and values towards food waste, indicating their developing Food Waste Literacy. The students' reported attitudes indicated that they were able to make better decisions involving food waste, like, being more acceptable towards sharing leftover food with others. The students seemed surer about the relationship between food being overbought and food getting wasted.
3. Evidence from this study suggests that the students would make better decisions involving food purchase and consumption. Their reported behaviour suggested that whenever they could, they would buy imperfect looking fruit and vegetables. They seemed more inclined towards getting leftovers packed for home. Moreover, almost all the students were making positive decisions about not wasting food and it had also translated in their improved behaviour towards the food that they brought for the school's morning breaks and lunches. This was distinctly visible in almost negligible food waste in the rubbish bin in the classroom.
4. Evidence from this study suggests that the intervention had helped in activating the students' inquiry in Food Waste Literacy. Their reported and observed responses suggested their curiosity and interest in Food Waste Literacy. They were very engaged in the topic and really wanted to address the topic. They were happy to talk to others about food waste and willing to pass on food waste knowledge. There were good indicators that they had developed literacy towards being good food citizens.
5. Evidence from this study suggests that the outcome of the intervention may have been positive because of many reasons. Firstly, it was an Enviroschool where the students and the teacher may already have had some pro environmental experiences. Those experiences could have paved the way for acceptance towards this food waste intervention. Secondly, the Principal and the class teacher were really enthusiastic and supportive about the study. The class teacher provided extensive support for the

implementation of the intervention. Thirdly, the students were part of an accelerated class where they had access to individual devices (chrome books) and extra learning support from the class teacher. Moreover, I was able to offer all the learning opportunities to the students which I had planned under the Unit.

6. This study may be used by other teachers as the intervention can be carried out by any teacher using guided-inquiry approach or any other pedagogy like mini-research projects, which may be appropriate for the students involved. The Unit for intervention may utilise the following core elements as its overarching principles: - knowledge of food waste including its scale, reasons, prevention, and environmental, social, and economic impacts; opportunities to examine the attitudes and values of students towards food waste in the light of this knowledge; ways to consider what behaviours lead to food waste and what can reduce it; and considerations to what barriers exist to reduce food waste for students and society. Teachers need to consider a hook to engage and inspire curiosity in students about food waste and a food waste audit in the classroom can be a good hook. The core concepts could have alternative sequences depending on the hook being used. Teachers in New Zealand may implement it for different Years of schooling, keeping in sight the achievement objectives of *The New Zealand Curriculum*.
7. Findings from this study have supported the initial conceptual framework proposed in Section 2.7 (Figure 2.4), with modifications. The modified conceptual framework is presented here (Figure 7.1). Findings from this study confirmed an impact of the food waste intervention guided by the central idea of social constructivism using an interpretive lens, in developing students' Food Waste Literacy in terms of their knowledge, attitudes and values, and behaviour towards food waste. The findings also indicated that as a consequence of the intervention, the students had begun making better decisions around food waste and inquiring about various aspects of food waste which was also an indication of their developing Food Waste Literacy.

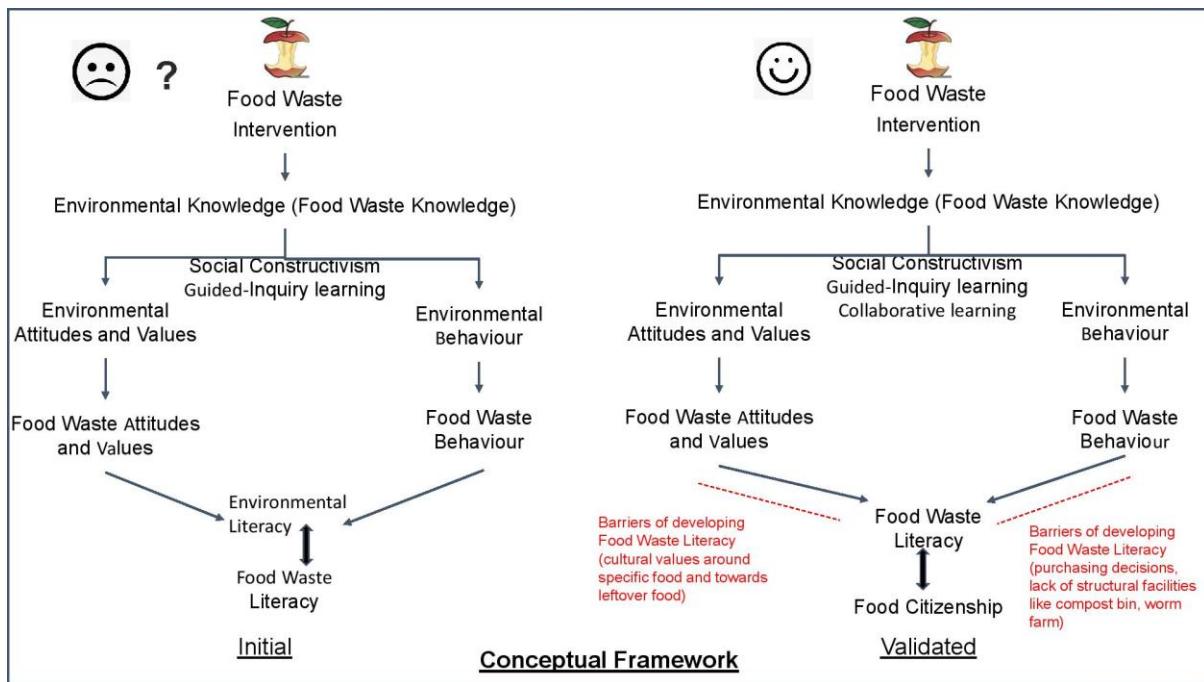


Figure 7. 1 Initial and validated conceptual framework for this study

However, there were also some barriers which were identified in the students' developing their Food Waste Literacy. Students' food waste attitudes and values may have barriers of cultural values around eating specific food, preparing excess food, and towards leftover food as culture plays an important role in relationship with food. Students' families may have food preferences which may be influenced by their cultural practices, resulting in some food patterns. Culture affects not only food consumption but also practices and behaviours (Sirieix, Lála, & Kocmanová, 2017). These food choices may lead to food waste and students may face this barrier for themselves and their families. Some students' families may be preparing extra quantity of food because of their cultural attitudes which places a strong emphasis on hospitality and over-catering for guests (Zhang, Duan, Andric, Song, & Yang, 2018). Students' food waste behaviour may have barriers of non-involvement in purchasing decisions with their families, non-involvement in packing and serving of food portions and lack of structural facilities like a compost bin or worm farm in their homes. Any amount of knowledge or education programme for students about food waste will not help in developing Food Waste Literacy unless it is supported by parents, supported by systems at home, and school and communities which reinforce this behaviour. The Food and Agricultural Organisation (FAO) facilitated this behaviour in children by investing in an educational programme to create food waste awareness in schools across a few countries (FAO, 2018a). The programme is aimed at empowering and equipping children to prevent food waste and introduce those behaviours to their families. Children's behaviours are socially constructed as a result of several influences

including their parents, peers, and teachers and if such sustainable actions of children are supported by parents who hold ultimate responsibility for household matters, the resulting joint actions are more likely to contribute to children's sustainable behaviour (Hosany, Hosany, & He, 2022, p. 237). Some barriers like household characteristics, cultural attitudes around specific food, and lack of appropriate structures may be difficult to change but many barriers may be diminished by being addressed. Research (Prabawa-Sear & Baudains, 2011) suggests that if infrastructure and opportunity is not available, students cannot be expected to engage in the environmentally responsible behaviour. It is therefore important that the relevant barriers are removed, and the resources are provided, in order to provide opportunities to students to engage in environmentally responsible behaviour and learn through participation in decision making and bringing about change.

Schools could remove some barriers, for students to develop their Food Waste Literacy by creating mini food banks in schools. Students might drop off their unopened/fresh food which can be enjoyed by another student who may not have access to that food or would like to eat it. Parents/ whānau (family) could be engaged in community food waste awareness events like volunteering with food banks. This engagement, on the one hand will expose parents/whānau to amount of food waste, but on the other hand will give them a first-hand experience of food insecure people in their community. These learning experiences may better equip them to support their children in developing their Food Waste Literacy. They might allow children portion control, food choice and self-regulation giving children agency over their food waste. An additional effort can be made by removing the barrier of existing policies around aesthetic standards of fruit and vegetables. Retailers should be able to sell imperfect fruit and vegetables and children can get a chance to exercise their decision making around buying them. Food is a precious commodity and food waste is highly unethical when millions of people around the world suffer from hunger. Food waste causes loss of finite natural resources, money, and effort at a huge environmental cost. As prevention of food waste is the most desirable action in the food recovery hierarchy, Food Waste Literacy has to be embedded in children's behaviour for a long-term solution to this problem of food waste.

7.4 Limitations of the study

Despite evidence that this study helped in developing Food Waste Literacy of the students, there were some limitations that are presented below.

First, in this study, I partly relied on self-reported behaviour, attitudes and values towards food waste. That is, the students were asked to self-report by filling in the pre- and post-survey questionnaire and participating in the focus group interviews before and after the intervention. I felt that due to possible negative connotation of wasting food or in fact wasting anything, the students may have possibly answered in a socially desirable manner. Moreover, the students may have developed a rapport with me and were behaving and answering in a favourable manner, hence the study outcomes might show different results for different teachers.

Second, for the purpose of generalizability of the study findings, the sample has to be a representative of the population. However, in my study, the sample was drawn from students of Year 7 in an intermediate school in North Island of New Zealand and as such, it cannot be considered a representation of all students in this adolescent age group in New Zealand. I had to choose the above-mentioned students as my sample because of various reasons, like, the school's readiness to participate in my study, and the school being an Enviroschool. A broader and more inclusive sample may have provided a better understanding of the impact of the intervention in developing Food Waste Literacy of the students. The findings from this study cannot therefore be generalized to more students of this age group in New Zealand but provide a starting point for similar research in different school settings and age groups.

Third, the intervention was short-term and in the absence of constant reinforcement, the reported Food Waste Literacy may not sustain and may not be long-term. However, the class teacher acknowledged the importance of reinforcement for maintaining the students' attitudes, values and behaviour towards food waste and had agreed to keep supporting her students, while they were with her, during that academic year.

Fourth, a food waste audit at the end of the intervention was not carried out which would have been useful to corroborate the students' change in behaviour towards food waste. Including a post-intervention food waste audit should be considered in future studies as it may help in comparing the quantity and types of food waste with pre-intervention audit. This may then lead to discussion about any changes in food waste behaviour in students and why it may have occurred. The data gained can provide insights in students' food waste behaviour and help

schools develop and/or continue intervention to reduce food waste, as the data will inform the effectiveness of the intervention and enable teachers to improve the programme.

Finally, the cultural aspect of food waste could not be included in the students' data. While there was a teaching-learning episode where students learnt about food waste in different cultures, in the avoidable versus unavoidable food waste teaching-learning episode, this was not included in the survey questionnaire and focus group interviews. Cultural influences may be important determinants in students' Environmental Literacy and Food Waste Literacy and can be a consideration in further research in this field.

7.5 Recommendations

The findings of this study have implications which can offer recommendations that may be considered by the curriculum decision makers, teachers, researchers and policymakers in New Zealand and in other countries.

7.5.1 Inclusion of Food Literacy and Food Waste Literacy under Environmental Literacy

Findings from this study reinforce the contribution, scope and importance of intervention in developing individuals' Environmental Literacy, Food Literacy, and Food Waste Literacy in particular. This supports the assertion by Hollweg *et al* (2011) that Environmental Literacy is not a condition of people possessing it or not. As an individual's Environmental Literacy develops and their knowledge base widens, attitudes and values may become more refined, and the environmental behaviour may become more effective. Environmental Literacy consists of knowledge and understanding of various environmental concepts, attitudes and values, and behaviour as the ultimate expression in the form of effective decisions (Hollweg et al., 2011, p. 16). The process of development of Environmental Literacy is not linear, yet it may develop over time by regular or intermittent interactions across the various components of Environmental Literacy. There is a need to broaden the scope of Environmental Literacy and include Food Literacy of which Food Waste Literacy should be a vital component. Knowledge about food waste should be included in Environmental Literacy to support and develop appropriate attitudes and values, and responsible behaviour towards reducing food waste. Just like the development of Environmental Literacy, which occurs on a continuum, the Food Waste Literacy can also develop by reflection, further learning, and additional experiences. Food Waste Literacy can empower people to make better food related decisions which may help to improve the sustainability of our food system. It is now, more than ever, that the world needs

food citizens and individuals need to be supported to develop food citizenship (O'Kane, 2016). The way forward towards individuals' developing their food citizenship can be thinking about how we eat and taking action to make sustainable food choices (Wilkins, 2005).

7.5.2 Inclusion of Food Waste Literacy across the curricula

Food waste education maybe included in different learning areas especially Science and Social Sciences with specified achievement objectives, in different levels, in the context of the implemented New Zealand Curriculum. The inclusion of food waste under Environmental Literacy in schools' curricula across nations could contribute to developing Food Waste Literacy and may help in combating the food waste issue.

7.5.3 Inclusion of Food Waste Literacy in teacher professional learning programme

Food Waste Literacy may be included in teacher professional learning programmes to motivate and empower teachers to create Food Waste Literacy amongst their students. My study data showed that this literacy was developed by the teacher as an outcome of the intervention.

7.5.4 Suggestions for further research

Findings from this novel study contribute to the growing prominence and the urgency of the food waste issue and its environmental, social and economic impacts. Evidence from this study therefore presents some suggestions for further research:

- A longitudinal study to develop Food Waste Literacy among students via a long-term intervention, as although a short-term intervention seems helpful and successful, it is uncertain whether the impact is durable. The outcome of such a longitudinal study could add to generalizability of this study.
- A study that explores the effectiveness of including Food Waste Literacy in different learning areas in school curricula.
- A study that explores the influence of different variables like cultural practices, socio-economic status of students, and other demographics on developing their Food Waste Literacy.
- A cross-sectional study that explores the development of Food Waste Literacy of different age groups.
- A study that explores the barriers of developing Food Waste Literacy amongst students. These barriers could be the abilities to engage with parents about purchasing decisions,

packing or serving food portions or the absence of structural availabilities like compost bins or worm farms.

- A study that explores the enablers of developing Food Waste Literacy amongst students. My study has established that young students have willingness and ability to develop in Food Waste Literacy. The study could explore the type of processes that could be put in place to support the actions that they might want to take to reduce food waste.
- A study that explores alternative approaches of developing Food Waste Literacy in students and evaluating their effectiveness. This may include maintaining food waste diaries and displaying weekly or monthly food waste data and its associated carbon impacts in schools.
- A study that explores the relationship between the levels of Food Waste Literacy and the per capita food waste production in schools and/or students' households.
- A study that explores the contribution of improving Food Waste Literacy towards improving students' overall Environmental Literacy.
- A study that explores the effectiveness of government policies and incentives (like pay-as-you-throw) on developing and sustaining the Food Waste Literacy of students.

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<https://doi.org/10.4304/tpls.3.2.254-262>

Appendices

Appendix A: Ethical Approval

Te Kura Toi Tangata
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The University of Waikato
Private Bag 3105
Hamilton, New Zealand, 3240

FEDU Ethics Committee
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24/1/2019

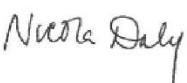
Dear Mrs. Deepa Goswami

FEDU Ethics Application Approved FEDU002/19

I am pleased to advise you that your ethics application for the project entitled "Reducing food wastage: An investigation of the food waste literacy of Years 7 and 8 New Zealand students." was approved by Te Kura Toi Tangata Faculty of Education Ethics Committee on January 23rd, 2019.

Please be aware that the Te Kura Toi Tangata FEDU Ethics Committee must be advised (by memo) of any changes to the details recorded in your ethics application. Please send any such advice to fedu.ethics@waikato.ac.nz. You will receive a memo of approval once the change(s) has been considered.

Kind regards

Co-chair

Te Kura Toi Tangata Faculty of Education Ethics Committee

Appendix B: Questionnaire for the students

Please answer the questions below. This is not a test, and it will not be marked.

Name - _____ Date- _____

For Questions 1-5 below, please tick one option from the following:

Agree a lot Agree Not Sure Don't Agree

1. If my family/whanau had a celebration/ special occasion I would like to:
A. share any leftover food with the guests.

Agree a lot Agree Not Sure Don't Agree

- B. pack any leftover food in the fridge to eat the next day.

Agree a lot Agree Not Sure Don't Agree

- C. throw the food in the rubbish bin.

Agree a lot Agree Not Sure Don't Agree

2. If people are given food which they don't want to eat, I don't think they have to eat it.

Agree a lot Agree Not Sure Don't Agree

3. I think that people buy too much food for themselves.

Agree a lot Agree Not Sure Don't Agree

4. When people throw away food, it causes environmental problems.

Agree a lot Agree Not Sure Don't Agree

5. I try to eat all the food given to me.

Agree a lot Agree Not Sure Don't Agree

6. In what sorts of places does food gets thrown away?

7. Where does unused food **finally** end up?

8. What resources are used for producing food? List as many as you can think of.

9. Food that is thrown away produces gas which is harmful to the environment. (tick one)

Agree a lot Agree Not Sure Don't Agree

10. I think food could be wasted in **New Zealand** in these places: (tick one)

A. On farms

Agree a lot Agree Not Sure Don't Agree

B. When it is being transported from place to place

Agree a lot Agree Not Sure Don't Agree

C. In supermarkets

Agree a lot Agree Not Sure Don't Agree

D. In homes, marae, restaurants and hotels

Agree a lot Agree Not Sure Don't Agree

11. I think, people waste food when they: (tick one)

A. Buy too much food

Agree a lot Agree Not Sure Don't Agree

B. Don't eat leftovers

Agree a lot Agree Not Sure Don't Agree

C. Store food poorly

Agree a lot Agree Not Sure Don't Agree

D. Don't understand food labels

Agree a lot Agree Not Sure Don't Agree

E. Cook too much food

Agree a lot Agree Not Sure Don't Agree

12. I would buy fruits and vegetables that are not perfect looking: (tick one)

Agree a lot Agree Not Sure Don't Agree

13. We waste the most **energy** when we throw away which of these foods: (tick one)

- bread
- eggs
- beef
- bananas

14. When I cannot finish my food at a fast-food place or at some other place, I ask to get it packed and take it home: (tick one)

- Rarely
- Sometimes
- Always
- I always finish my food

15. What ways can you think that people can help to reduce food waste?

Thanks for your time and helping with my research.



Appendix C: Pre-Intervention interview schedule for the teacher

- 1.** What are your views about food waste?
- 2.** Do you see it as a big problem in New Zealand?
- 3.** Have you seen anything happening in New Zealand about food waste?
- 4.** Are there appropriate possibilities in the *New Zealand Curriculum* for students to have learning experiences to develop awareness of environmental sustainability? Or how does *The New Zealand Curriculum* support learning and awareness about sustainability?
- 5.** What opportunities do you see in the New Zealand Curriculum for teaching and learning about food waste and its importance?
- 6.** Do you think teachers have any responsibility for engaging students to learn about food waste and why?
- 7.** Are you aware of any initiatives in the school about dealing with food waste?
- 8.** How do you think students in your class would respond to this topic? Do you think they have thought about this issue?
- 9.** How do you think helping students to learn about food waste might contribute to decision making about food waste?
- 10.** Do you think the students as future decision makers and citizens have any responsibility towards food waste?

Appendix D: Post-Intervention Interview Schedule for the Teacher

1. Have your views changed about food waste in response to this unit?
2. Were there any aspects of the learning which you found most surprising?
3. Do you think food waste is a problem in New Zealand also?
4. Do you see any further opportunities in New Zealand Curriculum for teaching and learning about food waste and its importance?
5. Do you think you have any responsibility for engaging students to learn about food waste and why?
6. Do you think you will continue to teach students about food waste? How might you do this?
7. What further initiatives in the school could be taken in the school about dealing with food waste?
8. How do you think students in your class have responded to this topic? Do you think the students will be more aware about food waste and its related issues after this unit?
9. So, they responded well?
10. How do you think helping students to learn about food waste might contribute to their decision making about food waste?
11. What do you feel has been learning from the professional perspective, being a part of this intervention?
12. Do you think the activities were adequate and appropriate for the students' learning?
13. Which activities do you think worked the best for learning about food waste? Why?

Appendix E: Students' Pre-Intervention Focus Group Interview

<u>Questions</u>
1. What comes to mind when you hear about food waste?
2. What kinds of food do people waste?
3. Can you think of some places where food is wasted?
4. Why do some people waste food?
5. Do you ever throw away food at home? Why does that happen?
6. How do you feel about that?
7. How do you think about people wasting food?
8. Do you think wasting food is a problem?
9. Do you think it is important to think and talk about food waste?
10. Why do you think it's important?
11. Can we do anything to stop food being wasted?

Appendix F: Students' Post-Intervention Focus Group Interview

Q 1-What comes to your mind when you hear about food waste?

Q 2- What kinds of food do you think people waste?

Q 3- Can you think of some places where food is wasted?

Q 4- Why do you think people waste food?

Q 5- How do you think about people wasting food?

Q 6- Do you think wasting food is a problem? Why?

Q 7- Do you think it's important to think and talk about food waste?

Q 8- Can we do anything to stop food being wasted?

Q 9- Do you any changes in your food waste habits since the start of this unit?

Q 10- What was the most surprising learning about food waste that you would like your family and friends to know about?

Q 11- Which activities did you like to learn about food waste and why?

Q 12- What have you learnt about food waste after this unit that you would like other children to know?

Appendix G: Class Observation Schedule

Students Engagement Observation Form

Date - _____ Time - _____ Lesson number & topic _____

Number of students- _____

Engaged students' listening		
Listening to the teacher/researcher	Eye contact is focused on the teacher/activity	Students make appropriate facial expressions, gestures, and posture shifts
Engaged students' responses		
Students are asking questions.	Students are answering questions/participating in an in-class discussion.	
Engaged students' behaviour		
Students are involved and showing interest	Students are liking the teaching material	

Researcher's personal reflection about students'- (about this task)		
Knowledge	Values	Behaviour
Any anecdotal recording		
Any note for future effectiveness		

Appendix H: School Principal's Information and Consent Letters



School Participation Letter

27th March 2019

Dear Mr., XX

I am writing to formally invite your school in a research study undertaken by me. The research is for my PhD and involves investigating *Food Waste Literacy in Years 7 and 8 in a New Zealand School*. Food waste is a huge problem all over the world and in New Zealand too. The research involves finding out about the current status of Food Waste Literacy amongst Intermediate students and the development of attitudinal and dispositional changes towards food waste, through a pedagogical intervention involving inquiry and decision making. The findings of the research aim to inform the design of a pedagogical unit in learning areas of Science, Social Sciences and Technology.

The research will be carried out under the supervision of Dr Chris Eames (Director, Technology, Environmental, Mathematics and Science Education Research Centre (TEMS) located within Te Hononga School of Education and Dr Philippa Hunter (Senior Lecturer, Social Sciences Education and Curriculum Studies) under Te Hononga School of Curriculum and Pedagogy.

The research will involve 2 phases:

Phase 1

1 A

- Pilot testing the questionnaire in another class of the same year as the main sample class (either Year 7 or 8). (15-20 minutes)

1 B

- Conducting a questionnaire survey after an initial pilot study in the school, about the Years 7/8 students' food waste awareness. (15-20 minutes)
- Interviewing the teacher to find out about her beliefs about food wastage (20 minutes) (audio recorded).
- Facilitating focus group discussions with students (pre-intervention). (10 minutes for group formation) (audio recording of the discussion).
- Teacher and researcher co-constructing a pedagogical intervention of 10-12 teaching episodes of 40-45 minutes each. (10 minutes for planning of each episode)

Phase 2

-

- Implementing the intervention's co-constructed teaching/learning episodes (10/12 episodes of 40/45 minutes)
- Collection of samples of students' classwork (photos or work samples).
- Repeating the teacher interview. (20 minutes) (audio recorded)
- Focus group discussions with students, 4-5 groups of 3/4 students (post intervention). (10 minutes for groups formation) (audio recording of the discussions).
- Repeating the questionnaire survey post intervention. (15-20 minutes)

The teacher involved is free to decline to be involved and can withdraw from involvement at any time during both the phases of the research.

Should you give permission for me to research and collect data in your school, I will seek informed consent from the teacher, parents and the students prior to commencing the research project and data collection. Any data collected from them will be kept confidential to me and the research supervisors, Dr Chris Eames and Dr Philippa Hunter. The students' and the teacher's interviews will be audio recorded with their consent and photos will be taken of the students' classwork.

While every effort will be made to maintain your school's anonymity, this cannot be guaranteed. Data collected from your school may be used in writing reports, publications or in presentations. Your name, the teacher's name and the students' names will not be used in any publications or presentations.

You can withdraw your school from involvement in the research at any time. This will mean that no further information will be gathered from the school for the research.

I would appreciate your formal permission for your school to be involved with this research project. If you need any more information about the research please contact me, Deepa Goswami, email- dg84@students.waikato.ac.nz or mobile number 0225926744.

In the event of any issue arising in the research again please contact me. If I cannot clarify the issue please contact the research supervisor, Dr Chris Eames (email chris.eames@waikato.ac.nz telephone- 07-838-4357).

If you give consent for the school to be involved in my research, please sign the attached consent form and kindly return to me.

Warm Regards.

Mrs Deepa Goswami, PhD student.

Faculty of Education, University of Waikato, Hamilton.

Research Consent Form – Principal



I have read the attached letter of information.

I understand that:

1. My school's participation in the project is voluntary.
2. I have the right to withdraw my school from the research at any time.
3. Informed consent will be gained from the teacher, the parents and the students involved before collecting any data from them for this research.
4. Data will be collected from my school in the ways specified in the accompanying letter. This data will be kept confidential and securely stored.
5. Data obtained during the research project will be used in the writing of reports or published papers and making presentations. This data will be reported without use of my name, the name of my staff, my students or the name of the school.
6. I acknowledge my teacher/s involved in the research will commit to carry out the initial questionnaire pilot study (15/20 minutes), final questionnaire (pre and post) (15/20x2=30/40 minutes), his/her pre and post interview (30x2=60 mins), reading the transcript (2x20=40 mins.), organizing students focus group discussion (pre and post) (5 mins.), co-construct a pedagogical intervention with the researcher at times suitable to both of them (approx. 2-3 hours outside the class) and implement 10-12 teaching episodes (as part of the pedagogical intervention) in the presence of the researcher (each class of about 40 mins.), post-class discussion by email or in person (5-8 mins.). Students will answer initial pilot questionnaire (15/20 mins.), pre and post intervention questionnaire (15/20 x 2=30/40 mins.), focus group interviews (20 mins. each group) and attend 10/12 classes of 40/45 mins. each.
7. I acknowledge the researcher will visit the school in the first term of 2019 to carry out the phase1 and carry out the phase 2 in the second and third terms of 2019.
8. I can direct questions to the researcher. Mrs Deepa Goswami at dg84@students.waikato.ac.nz mobile 022-592-6744.

For unresolved issues I may contact the research supervisor, Dr Chris Eames at chris.eames@waikato.ac.nz tele 07-838-4357.

I give consent for my school to be involved in the project under the conditions set out above.

Name: _____

Signed: _____

Date: _____

Please return to:

Deepa Goswami. School of Education, University of Waikato, Hamilton.

Appendix I: Teacher's Information and Consent Letters



Teacher Information Letter

27th March 2019

Dear Miss XX

I am seeking your participation in a research study as part of my PhD. The research involves investigating *Food Waste Literacy in Year 7 and 8 in a New Zealand School*. Food waste is a huge problem all over the world and in New Zealand too. The research involves finding out about the current status of Food Waste Literacy amongst Intermediate students. It will explore developing attitudinal and dispositional changes towards conceptions about food waste through a pedagogical intervention. The findings of the research aim to inform the design of a pedagogical intervention across learning areas of Science, Social Sciences and Technology.

The research will be carried out by me under the supervision of Dr Chris Eames (Director, Technology, Environmental, Mathematics and Science Education Research Centre (TEMS) located within Te Hononga School of Education and Dr Philippa Hunter (Senior Lecturer, Social Sciences Education and Curriculum Studies) under Te Hononga School of Curriculum and Pedagogy.

The research will involve 2 phases as mentioned under

Phase 1

Phase 1 A

- Pilot testing the questionnaire in another class of the same year as the main sample class (either Year 7 or 8)

Phase 1 B

- I would like to conduct a questionnaire survey in your class after an initial pilot study in the school, about the Years 7/8 students' food waste awareness. (15-20 minutes)
- I would like to interview you to find out about your beliefs about food wastage. (20 mins) (audio recorded).
- You will have the opportunity to read the transcribed interview (10 minutes).
- I would like you to organize 3-4 students for a focus group discussion with me (pre-intervention). (15 minutes for group formation)
- You and I will co-construct a pedagogical intervention of 10-12 teaching episodes of 40-45 minutes each. (Time involved will depend on level of planning but may be 2-3 hours).

Phase 2

- I would like you to implement the intervention's co-constructed teaching/learning episodes. (10/12 episodes of 40/45 minutes)
- I would like you to collect samples of students' classwork (photos or real samples).
- I would like to interview you again after the intervention is over. (20 minutes) (audio recorded) and reading its transcript (10 minutes).
- I would like you to organize the students into 3 groups of 4 students each for focus group discussions with me (post-intervention). (5 minutes for groups formation)
- I would like your help to administer the questionnaire survey to students, post-intervention. (15-20 minutes).

Your participation in the study is voluntary and you will be free to withdraw from involvement at any time during phases 1 and 2. If you have any concerns about the study at any time, please raise them with me.

Should you give permission for me to research and collect data in your class, I will seek informed consent from the students and parents of your class, prior to commencing the research project and data collection. Any data collected from them will be kept confidential with me and the research supervisors, Dr Chris Eames and Dr Philippa Hunter. The students' and your interviews will be audio recorded with your and the students' consent and photos may be taken of the students' work.

While every effort will be made to maintain your school's anonymity, this cannot be guaranteed. Data collected from your class may be used in writing reports, publications or in presentations. Your name and the students' names will not be used in any publications or presentations.

I would appreciate your permission for your class to be involved with this research project. If you need any more information about the research please contact me, Deepa Goswami, email-dg84@students.waikato.ac.nz or mobile number 0225926744.

In the event of any issue arising in the research again please contact me. If I cannot clarify the issue please contact the research supervisor, Dr Chris Eames (email chris.eames@waikato.ac.nz telephone- 07-838-4357).

If you give consent for the class to be involved, please sign the attached consent form and kindly return to me.

Warm Regards.

Mrs Deepa Goswami, PhD student, Faculty of Education, University of Waikato, Hamilton.



Research Consent Form – Teacher

I have read the attached letter of information.

I understand that:

1. My participation in the project is voluntary.
2. I have the right to withdraw from the research at any time.
3. Informed consent will be gained from the students and parents/carers before collecting any data from them for this research.
4. Data will be collected from my class in the ways specified in the accompanying letter. This data will be kept confidential and securely stored.
5. Data obtained during the research project will be used in the writing of reports or published papers and making presentations. This data will be reported without use of my real name, the name of my students or the name of the school.
6. I acknowledge and commit to carry out all the activities mentioned in Phase 1 and 2 in the Information Letter.
7. I acknowledge the researcher will visit the school in the first term of 2019 for Phase 1 and in the second and third terms of 2019 for Phase 2 of the research.
8. I can direct questions to the researcher. Mrs Deepa Goswami at dg84@students.waikato.ac.nz mobile 022-592-6744.

For unresolved issues I may contact the research supervisor, Dr Chris Eames at chris.eames@waikato.ac.nz phone 07-838-4357.

I give consent for my class to be involved in the project under the conditions set out above.

Name: _____

Signed: _____

Date: _____

Class/Year: _____

Number of Students: _____

Please return to:

Deepa Goswami. PhD student

School of Education, University of Waikato, Hamilton.

Appendix J: Students' and Parents' Information and Consent Letters



Parents' Information Letter

December 2018

Dear Parents/Guardians/Carers

I am writing to ask your permission to formally include your child in a classroom-based research study. The research is for my PhD and involves investigating *awareness about Food Waste Literacy in Years 7 and 8 in a New Zealand School*. Food waste is a huge problem all over the world and in New Zealand too. The research involves finding out understanding of food waste amongst Intermediate students and suggesting ways to further improve awareness towards food wastage.

The research is based in your child's school and will be carried out by me under the supervision of Dr Chris Eames (Director, Technology, Environmental, Mathematics and Science Education Research Centre (TEMS) located within Te Hononga School of Education and Dr Philippa Hunter (Senior Lecturer, Social Sciences Education and Curriculum Studies) under Te Hononga School of Curriculum and Pedagogy. The research will involve 2 phases as under.

Phase 1

- Conducting a questionnaire survey after an initial pilot study in the school, about the Years 7/8 students' food waste awareness.
- Interviewing the teacher to find out about her beliefs about food wastage.
- Facilitating focus group discussions with students (pre-intervention).
- Teacher and researcher co-constructing an intervention of 10-12 teaching episodes of 40-45 minutes each.

Phase 2

- Implementing the intervention's co-constructed teaching/learning episodes.
- Collection of samples of students' classwork.
- Repeating the teacher interview.
- Focus group discussions with students (post intervention).
- Repeating the questionnaire survey (post intervention).

I have received informed consent from the school Principal and the home teacher, and I now seek your permission to carry out my research and collect data with your child. Any data collected from the students will be kept confidential to me and the research supervisors, Dr Chris Eames and Dr Philippa Hunter.

Every effort will be made in the research to keep your child's participation confidential and to ensure your child's anonymity. The school's, the teacher's name and your child's names will not be used in any publications or presentations.

You can withdraw your child from involvement in the research at any time. This will mean that no further information will be gathered from your child for the research.

I would appreciate your permission for your child to be involved with this research project. If you need any more information about the research please contact me, Deepa Goswami, email- dg84@students.waikato.ac.nz or mobile number 0225926744.

In the event of any issue arising in the research again please contact me. If I cannot clarify the issue please contact the research supervisor, Dr Chris Eames (email chris.eames@waikato.ac.nz telephone- 07-838-4357.

If you give consent for the child to be involved, please sign the attached consent form and kindly return to me.

Warm Regards.

Mrs Deepa Goswami

PhD student, Faculty of Education.

University of Waikato, Hamilton.

"This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 23rd Jan. 2019. Approval number: FEDU002/19".

Research Consent Form – For the Parents/whanau/guardians/Carers and the Students

I have read the attached letter of information.

I understand that:

1. My child's participation in the project is voluntary.
2. My child has the right to withdraw from the research at any time.
3. Approval and consent have been gained from the school Principal and the classroom teacher before collecting any data from my child for this research.
4. Data will be collected from my child in the ways specified in the letter. This data will be kept confidential and securely stored.
5. Data obtained during the research project will be used in the writing of reports or published papers and making presentations. This data will be reported without use of my child's name or the name of the school.
6. I understand the researcher will visit the school in the first, second and third terms of 2019.
7. I can direct questions to the researcher. Mrs Deepa Goswami at dg84@students.waikato.ac.nz mobile 022-592-6744.

For unresolved issues I may contact the research supervisor, Dr Chris Eames at chris.eames@waikato.ac.nz ph. 07-838-4357.

I give consent for my child to be involved in the project under the conditions set out above.

Name of the Parent: _____

Parent's signature: _____

Date: _____

Child's name: _____

Child's signature: _____

Please return to:

Deepa Goswami. PhD student.

Faculty of Education, University of Waikato

Hamilton.

"This research has been approved by the University of Waikato Faculty of Education Ethics Committee on 23rd Jan. 2019. Approval number: FEDU002/19".

Appendix K: Lesson Plans
Lesson 1- Food Waste Audit

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	Introductory question- what is waste? What is food waste? Do we all waste food? (Open phase- whole class was inquiring into the amount of food waste in their class which occurred every day, in a week, in a school term, in one year and in the entire school.)
Wider topic	The students will be asked to put their leftover food in their lunch boxes, in a plastic bag, after the lunch break is over. They will do it discreetly so that other students don't see each other's quantity of leftover food. It will be sorted into avoidable and unavoidable food waste. Avoidable food waste will be weighed to have an idea of food wasted by approximately 25-30 students in a day. The students will then multiply the amount with 5 to arrive at food wasted in a school week, then multiply by 20 to arrive at food wasted in a school month and so on. The total amount will then be divided by the total number of students to assess average individual food waste. The students would learn that if every class wasted the same amount how much would the whole school waste in a year. It will be multiple times the number of classrooms in the school.
Selected context and setting/s	
XXX School. 45 mins. (after lunch break)	
Focus question	This activity demonstrates average food wasted by individuals and draws the students' attention towards the scale of food waste.
Knowledge/ Information Intentions involve	
NZC Achievement Objective	
The students will participate and contribute in 'Nature of Science' by exploring various aspects of food waste issues.	
Key concepts/ Ideas	

<p>Waste, food waste, scale of food waste.</p> <p>LaNZ</p> <p>Food waste is happening in New Zealand like other countries.</p> <p>Perspective emphasis</p> <p>The students will know about the amount of food waste which happens in everyday life.</p> <p>Specific knowledge learning intentions</p> <p>The students will develop understanding that each individual is responsible for causing food waste although minimally, which eventually ends up in a substantial amount.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students will learn about the concept of food waste by measuring the wasted food.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>The students’ leftover food in the lunch boxes, plastic bag, weighing scales, worksheet.</p>

Lesson 2- KWL chart about food waste

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	<p>Preparing KWL chart about food waste.</p> <p>Some cues about food waste will be provided like: - You all witnessed food wasted from your lunch boxes in the previous class. Based on that experience and other personal experiences, complete the tables here about what you already know about food waste and what you would want to know about food waste. (Immerse phase-inquiry question was ‘what do I want to know about food waste’). The students will work in groups and complete K and W component of the chart.</p>
Wider topic Food waste Selected context and setting/s XXX School. 40 mins.	<p>A representative from each group will then talk about his/her group’s K and W write up. Teacher and the students can keep discussing the various points raised by the students.</p> <p>These sheets will be collected as evidence.</p> <p>L component will be finished in the last class. (K= what I know, W= what I want to know, L= what I learned)</p>
Focus question What do I want to ‘know’ about food waste?	
Knowledge/ Information Intentions involve NZC Achievement Objective The students will participate and contribute in ‘Nature of Science’ by exploring various aspects of food waste issues. Key concepts/ Ideas Food waste, knowledge of food waste, curiosity about food waste.	

<p>LaNZ</p> <p>Food waste is happening in New Zealand like other countries.</p> <p>Perspective emphasis</p> <p>The students will know about the importance of food waste which happens in everyday life.</p> <p>Specific knowledge learning intentions</p> <p>The students will develop understanding that food waste is happening all around us and we need to learn more about this issue.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge about food waste and allowing them to extend it, to know more about the food waste problem.,</p> <p>Specific skills process learning intentions</p> <p>The students develop skills of thinking and consolidating their thoughts by presenting it to the other classmates.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as students will make sense of the idea of food waste and construct further knowledge about it.</p> <p>Key resource/s teaching materials</p> <p>KWL worksheet</p>

Lesson 3- Scale of food waste

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	<p>Explore phase- the whole class was inquiring about the scale of food waste globally and in New Zealand</p>
Wider topic Food waste	<p>Discussion questions- In our food waste activity in the class, we found out about the food wasted by all the students. Do you think food is wasted, similarly by most of the people in New Zealand?</p>
Selected context and setting/s XXX School. 45 mins.	<p>Do you think food is wasted in other countries too? Class discussion will be followed by viewing three videos about food waste. The first video is about food wasted around the world – the students will be told about the relevance of the video that it describes the amount of food waste around the world.</p>
Focus question <p>How ‘Food waste’ issue is important, both for New Zealand and the world and that decisions have to be made about possible actions.</p>	<p>https://www.youtube.com/watch?v=7QbHIWN0yp4 02:12</p> <p>The students will answer a short, written quiz after watching this.</p>
Knowledge/ Information Intentions involve	<p>The second video is about food waste in New Zealand, created by ‘Love Food Hate Waste.’ The students will be informed about the video and the organization which had carried out the research work in New Zealand. The students will be asked to watch the video carefully as they will have to answer a few questions after viewing the videos.</p>
NZC Achievement Objective <p>The students will understand that events (food waste) have causes and effects.</p>	<p>https://www.youtube.com/watch?v=YygDqGqsrou 04:50</p> <p>The students will answer a short, written quiz after watching this.</p>
Key concepts/ Ideas <p>Food waste, global issue, interconnected.</p>	<p>And the third video is about saving money by not wasting food</p> <p>https://www.youtube.com/watch?v=8fDFg4NHbAQ 00:38</p> <p>The viewing of the videos will be followed by a class discussion where the students will share and</p>

<p>LaNZ</p> <p>Food waste is happening in New Zealand like some other countries.</p> <p>Perspective emphasis</p> <p>The students will know about the amount of food waste which is happening in New Zealand and the rest of the world.</p> <p>Specific knowledge learning intentions</p> <p>The students will develop understanding that each individual is responsible for causing food waste although minimally, which eventually ends up in a substantial amount.</p>	<p>ask about their understanding of the videos and thoughts related to them.</p> <p>Pairs of students will be asked to inquire about edible, potentially edible and inedible parts of any two fruits or vegetables. Also, about any dishes which are usually prepared from the inedible parts of fruits or vegetables (for the next class).</p>
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students understand that food waste is occurring in New Zealand also like other parts of the world.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Videos of food waste, quiz worksheet.</p>

Lesson 4: Edible, potentially edible, and inedible parts of fruit and vegetables.

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	Inquiry learning about what parts of fruits and vegetables are edible, potentially edible and inedible. For example, potentially inedible part of beetroot leaves, can be eaten just like silver beet leaves, instead of being wasted. Also inquire about the use of potentially edible parts in various cultures like use of watermelon rind as deep-fried dish in South America. (Explore – inquiring into influence of culture in what we eat and waste.)
Wider topic Food waste	The students will be asked to write about the edible, potentially edible and inedible parts of the any two common fruit and vegetables, as a part of the inquiry. Then they will be asked to share it with the class. Later the information sheet prepared by the teacher will be discussed in the class (see attached sheet at the end of the lesson plan). A video will also be shown about using parts of fruits and vegetables which are usually discarded. https://www.youtube.com/watch?v=9AFqwyHAj1I 01:16
Selected context and setting/s XXX School. 45 mins.	
Focus question How can cultures influence how and what we eat and waste?	
Knowledge/ Information Intentions involve	
NZC Achievement Objective The students will understand how people pass on and sustain culture (of food waste) for different reasons and this has consequences for people.	
Key concepts/ Ideas The students will gain knowledge, skills, and experience to understand how cultural practices reflect and express peoples' customs, traditions, and values.	
LaNZ	

<p>How the cultures of people in New Zealand are expressed in their daily lives.</p> <p>Perspective emphasis</p> <p>The students will know about the amount of food waste which happens in everyday life.</p> <p>Specific knowledge learning intentions</p> <p>The students will learn how to waste less food, how culture can influence how and what we eat.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students develop the skills of wasting less food by becoming aware of different ways of eating potentially inedible parts of fruit and vegetables.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Inquiry through internet, work sheet.</p>

Fruit	Edible	Potentially edible	Inedible
Bananas	White flesh	Banana skin and banana flower– this is turned into curry in India.	Stem
Oranges/grapefruit/mandarins	Orange flesh	Peel - this can be candied and used in mixed peel, or it can be turned into marmalade.	seeds
Peaches	Yellow flesh	Skin - some people choose to peel their peaches.	Stone/pit
Nectarine	Yellow flesh & skin		Stone/pit

Watermelon	Pink flesh	White flesh - can be used to make chutney. Rind - can be deep fried. Pips - they can be chewed and swallowed.	
Strawberries & other berries	Pink flesh		Green leaves and stem
Grapes	Green flesh	Skin - in Japan they always peel grapes before eating them. Pips - they can be swallowed.	
Mango	Yellow flesh		Stone and peel
Pineapple	Yellow flesh	Core - this can be used to make pineapple tea or vinegar.	Skin
Pears	White flesh	Skin - some people choose to peel pears	Stem

Vegetable	Edible	Potentially edible	Inedible
Cauliflower	White florets	Stalk - this can be cooked and turned into soup Leaves - these can be turned into pesto.	
Broccoli	Green florets	Stalk - this can be grated and turned into broccoli slaw. Leaves - these can be turned into pesto.	
Silver beet	Green leaves	Stalk - these take longer to cook than the leaves but are still edible.	
Leeks	White stalk	Green leaves - these take longer to cook than the stalk but are still edible. Roots - these can be stir-fried and eaten.	
Potatoes/kumara	White/yellow flesh	Skins - some people remove the skin for mashed potato, others keep the skins for jacket potatoes.	
Pumpkin	Orange flesh	Skins - these can be eaten. Seeds - these can be roasted, and the inside flesh eaten.	
Carrots	Orange flesh	Leaves - these can be made into pesto.	
Beetroot	Purple flesh	Skins - these can be eaten. Stalks - these can be stir-fried.	roots

		Leaves - these are similar to silver beet.	
Coriander	leaves	Stalks - these can be stir-fried. Roots - these are used to make curry pastes.	
Lettuce	leaves	Outer leaves - these can be washed and eaten. Core - this can be cooked and eaten like cabbage.	roots
Celery	stalks	Leaves - these can be stir-fried or used in soups. Hearts - these can be used in coleslaw.	
Cabbage	leaves	Outer leaves - these can be washed and eaten. Core - this can be made into sauerkraut.	

In the Southern States of America, people eat deep fried watermelon rind; in England people eat the rind of oranges and grapefruit when they make marmalade; in Asia people eat fish heads and pig trotters are eaten in New Zealand.

Lesson 5- Harmful effects of food waste on the environment

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	Inquiry questions- Do you think that food waste can have harmful effects on the Earth's environment? How do you think it can affect the environment? Have you heard about greenhouse gases and global warming?
Wider topic Food waste	The students' responses will be written down on the board and later discussed for their correctness after watching the videos.
Selected context and setting/s XXX School. 45 mins.	Video on relationship between greenhouse gases and global warming https://www.youtube.com/watch?v=dw9KO9JsGGk 04:16 The students will answer a small quiz based on this video. It will be followed by a video about the harmful effects of food waste along with the class discussion and teacher's inputs. https://www.youtube.com/watch?v=RkgCr3GHaJs 06:47 by EPA
Focus question What are the harmful effects of the food waste on the environment?	https://www.youtube.com/watch?v=smIUPfvCN7k 01:32 by FAO https://www.youtube.com/watch?v=BmDZU1UTBeY 01:43
Knowledge/ Information Intentions involve	The students will be asked to demonstrate their understanding of the harmful effects through a drawing at the bottom of the worksheet.
NZC Achievement Objective The students will understand that events (food waste) have causes and effects.	
Key concepts/ Ideas Harmful effects of food waste	

<p>LaNZ</p> <p>Food waste happening in New Zealand, is also contributing to harmful effects on the environment.</p> <p>Perspective emphasis</p> <p>The students will know about the harmful effects of food waste on our environment.</p> <p>Specific knowledge learning intentions</p> <p>The students will develop understanding that food waste is also responsible for harming the environment by producing a harmful gas called methane.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students reinforce the idea of harmful effects of food waste.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Videos, worksheet.</p>

Lesson 6- Effects of global warming being contributed by food waste, on New Zealand.

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	<p>Inquiry questions- Do you think the global warming will affect New Zealand? How? Will this town also be affected by global warming? How?</p>
Wider topic Food waste	<p>Students will view two videos about the impact of global warming on New Zealand.</p> <p>https://www.youtube.com/watch?v=Qojo4L0JoMs</p>
Selected context and setting/s XXX School. 30 mins.	<p>https://www.youtube.com/watch?v=jnD9koY_EeE till 06:30</p>
Focus question What will be the impact of global warming on New Zealand and on the local life of this town?	<p>Local flooding in April 2018 to understand impact on local life of this town.</p> <p>https://www.youtube.com/watch?v=EvWivLszcmU</p>
	<p>https://www.nzherald.co.nz/rotorua-daily-post/video/news/video.cfm?c_id=1503430&gal_cid=1503430&gallery_id=192200</p>
	<p>https://www.stuff.co.nz/environment/climate-news/110024475/in-hot-water-how-climate-change-is-affecting-our-treasured-lakes</p>
Knowledge/ Information Intentions involve NZC Achievement Objective The students will understand that events have causes and effects. Key concepts/ Ideas Impact of global warming.	

<p>LaNZ</p> <p>Climate change is affecting New Zealand like other countries.</p> <p>Perspective emphasis</p> <p>The students will know about the impact of global warming on New Zealand.</p> <p>Specific knowledge learning intentions</p> <p>The students will develop understanding that humans are responsible for causing food waste which in turn is affecting the climate in an adverse manner.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students will learn about the impact of global warming on New Zealand.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Videos on global warming and floods in this town in April 2018.</p> <p>A worksheet</p>

Lesson 7- Journey of food from farm to table

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	<p>Students will inquire about journey of food from farm to table. How food is produced, harvested and reaches consumer and also wasted. They will be guided by these discussion questions- Have you ever wondered from where do we get bread? How does it reach the supermarket? What is it made of?</p>
Wider topic	<p>Food waste</p>
Selected context and setting/s	<p>XXX School. 40 mins.</p>
Focus question	<p>What journey does food make to reach our table?</p>
Knowledge/ Information Intentions involve	<p>NZC Achievement Objective</p> <p>The students will participate and contribute in ‘Nature of Science’ by exploring various aspects of food waste issues. The students will also (AO of Social Sciences) gain understanding to understand how producers and consumers exercise their rights and should meet their responsibilities.</p>
Key concepts/ Ideas	<p>Production, transportation, storage, distribution of food.</p>

<p>LaNZ</p> <p>Perspective emphasis</p> <p>Students will know about the long journey of food from farm to table, involving the use of various resources.</p> <p>Specific knowledge learning intentions</p> <p>The students will learn that wasting food is also wasting the resources involved.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students develop the understanding of wasting less food or no food by becoming aware of the resources used in making the food available to us.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Videos about journey of food items, worksheet.</p>

Lesson 8- What are food miles?

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	
Wider topic	Inquiry into food miles
Food waste	
Selected context and setting/s	
XXX School. 45 mins.	
Focus question	
What are ‘Food miles’ and how	
do we reduce them?	
Knowledge/ Information Intentions involve	
NZC Achievement Objective	
The students will participate and	
contribute in ‘Nature of Science’ by	
exploring various aspects of food waste	
issues.	
Key concepts/ Idea	
Food miles	
LaNZ	

<p>Food waste is happening in New Zealand like other countries.</p> <p>Perspective emphasis</p> <p>The students will know that wasting food which has travelled a long distance also wastes more resources.</p> <p>Specific knowledge learning intentions</p> <p>The students will develop an understanding that buying food, which is produced locally or in the country, involves less resources.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students develop the skill of reading the food labels and understand how far that food has travelled to reach them.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as the students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>A few empty food packets/tins/ food labels, world map and</p> <p>https://www.foodmiles.com/</p>

Lesson 9- Imperfect looking Fruit and Vegetables

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	Some misshapen, bruised fruits and vegetables, and some perfect fruits will be used as hook (if available), or their pictures will be used. (Inquiry into imperfect looking fruit and vegetable).
Wider topic	Food waste
Selected context and setting/s	Discussion questions- Which fruits/vegetables would you buy out of the two lots? Why? Why not?
XXX School. 45 mins.	It will be followed by a class discussion and viewing of the two videos. The students will learn that such fruit and vegetables
Focus question	form about 10% of the food waste. It will create an awareness about buying misshapen fruits and vegetables and understanding that those fruit and vegetables are equally good in all the ways.
Why buying imperfect looking fruit and vegetables is important to reduce food waste?	<p>https://www.youtube.com/watch?v=Gi4iSrdlOXk 02:45</p> <p>https://www.youtube.com/watch?v=0s6H7DpBo2c 02:40</p> <p>https://www.youtube.com/watch?v=qQQMygivn0g&t=6sIntermarche</p>
	The students will observe a huge collection of pictures of imperfect fruit and vegetables on-
	https://www.ulwestphal.de/mutatoes/index.html
Knowledge/ Information Intentions involve	The students will first draw a fruit or vegetable of their choice
	and watch the videos and participate in the class discussion.
	Then they will be asked to draw the same fruit or vegetable but
	an imperfect looking and also give a reason for choosing a
	perfect or imperfect fruit /vegetable.
NZC Achievement Objective	

<p>pass certain cultures (of discarding imperfect looking fruits/vegetables) for different reasons and that this has consequences for people.</p> <p><i>Key concepts/ Ideas</i></p> <p>Imperfect looking fruit and vegetables</p> <p><i>LaNZ</i></p> <p>Food waste is happening in New Zealand like other countries.</p> <p><i>Perspective emphasis</i></p> <p>The students will know about the worth of imperfect fruits and vegetables.</p> <p><i>Specific knowledge learning intentions</i></p> <p>The students will learn that imperfect looking fruit and vegetables are equally good, and we need not discard them.</p>	
<p><i>Process skills Intentions</i></p> <p><i>Indicate the process emphasis</i></p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to</p>	<p><i>Key competency/ cultural competency reinforcement)</i></p> <p>The key competency of ‘Thinking’ is involved as students will make sense of the experience involved.</p>

<p>apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students will learn to buy such fruits and vegetables whenever they have an opportunity.</p>	<p>Key resource/s teaching materials</p> <p>A few bruised, misshapen fruits and vegetables, and a few perfect fruits/vegetables or their pictures, videos of such fruits and vegetables.</p> <p>Worksheet.</p>
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Lesson 10- Understanding Food Labels, ‘use-by’ and ‘best-by’

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	(Inquiry into food labels) Discussion questions- What would you find written on a milk can- use by or best by, on meat – use by or best by, on sugar packet- use by or best by? So, what could be the difference between ‘best by’ and ‘use by’?
Wider topic Food waste	The empty food packets brought by the teacher and the students will be read for their ‘use by’ and ‘best by’ dates to understand the true meaning and implications of food labels which also contribute to a large amount of food being wasted.
Selected context and setting/s XXX School. 45 mins.	The students will find out more about these food labels from the New Zealand government site- https://www.mpi.govt.nz/food-safety/food-safety-for-consumers/understanding-food-labels/how-to-read-food-labels/ and http://www.foodstandards.govt.nz/consumer/labelling/dates/Pages/default.aspx The students will watch a video on food labels https://www.youtube.com/watch?v=HlJCzMsy8Wk video 01:13
Focus question What is the meaning of different food labels like ‘use by,’ ‘best by’?	
Knowledge/ Information Intentions involve	
NZC Achievement Objective The students will participate and contribute in ‘Nature of Science’ by exploring various aspects of food waste issues.	The students will list five foods each under ‘best by’ and ‘use by’ dates on a worksheet.
Key concepts/ Ideas Food labels, use by, best by	
LaNZ Food waste is happening in New Zealand like other countries.	

<p>Perspective emphasis</p> <p>The students will know about the food waste because of ignorance about food labels.</p> <p>Specific knowledge learning intentions</p> <p>The students will learn that food is safe to consume before ‘use by’ date and also safe to consume after ‘best by’ just that the food may not taste the best after the ‘best by’ date.</p>	
<p>Process skills Intentions</p> <p>Indicate the process emphasis</p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students will learn the difference between the different types of food labels.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>A few empty food boxes/packets, video, government of New Zealand website about understanding food labels</p> <p>Worksheet.</p>

Lesson 11- Learning about the cost of day-to-day food items

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	(inquiry into the cost of common food items). The students will be allotted a virtual budget of 100 dollars to do virtual online grocery shopping. The activity will be carried out by students in groups of 3. The students will use internet to find the costs of common foodstuffs like milk, eggs, bread, meat, juice, potato, onion etc. in different supermarkets like Pak'nSave, Countdown and find out how much each product costs.
Wider topic	
Food waste	
Selected context and setting/s	
XXX School. 45 mins.	
Focus question	
What does different food items cost?	
Knowledge/ Information Intentions involve	
NZC Achievement Objective	
The students will be engaged in	
thinking that events have consequences	
and their responsibilities as consumers.	
Key concepts/ Ideas	
cost of food	
LaNZ	
Food waste is happening in New	
Zealand like other countries.	
Perspective emphasis	
The students will know about the cost	
of different food items.	

<p>Specific knowledge learning intentions</p> <p>The students will learn how much each food item costs and how much money is wasted by wasting that food.</p>	
<p>Process skills Intentions</p> <p><i>Indicate the process emphasis</i></p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students will learn the cost of common food items and also that wasting food results in wasting money too.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>The students’ virtual online grocery list worksheet, internet search.</p>

Lesson 12- Recycling of food by composting

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	The student will carry out an inquiry about the ways to recycle food, including composting and can compost bin be used for food waste.
Wider topic	
Food waste	
Selected context and setting/s	
XXX School. 45 mins.	Class discussion on the good points about composting followed by viewing the video about how to make a compost bin.
	https://www.youtube.com/watch?v=dRXNo7Ieky8 05:56
	https://www.youtube.com/watch?v=Njbn34JrKnE 04:04
Focus question	https://www.stuff.co.nz/timaru-herald/news/102630629/food-scrapss-useful-for-compost-ending-up-in-landfill
	The students will be asked to complete a worksheet on what can be put and what cannot be put in a compost bin.
Knowledge/ Information	
Intentions involve	
NZC Achievement Objective	
The students will gain knowledge to understand how people participate individually and collectively in response to community challenges.	
Key concepts/ Ideas	
Composting food waste	
LaNZ	
Food waste is happening in New Zealand like other countries.	
Perspective emphasis	
The students will know about recycling food waste.	

<p>Specific knowledge learning intentions</p> <p>The students will learn that composting food waste is a better solution than letting the food waste go in the rubbish and ending in a landfill.</p>	
<p>Process skills Intentions</p> <p><i>Indicate the process emphasis</i></p> <p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students will learn the skill of setting up a compost bin.</p>	<p>Key competency/ cultural competency reinforcement</p> <p>The key competency of ‘Thinking’ is involved as students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Internet, notebook, worksheet</p>

Lesson 13- Food Waste and Food Rescue

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	
Wider topic	
Food waste	A talk will be organized about food waste and rescue efforts in this town, by a food rescue worker. (Inquiry supported by food waste worker about reuse and recycling of food waste).
Selected context and setting/s	
XXX School. 30 mins	
Focus question	
How much food is wasted in this town alone and how some of it is rescued?	He will present the scale of food waste in the town and how the donated food is being made available to the people who cannot afford to buy their own food.
Knowledge/ Information Intentions involve	
NZC Achievement Objective	
The students will participate and contribute in ‘Nature of Science’ by exploring various aspects of food waste issues.	
Key concepts/ Ideas	
Food waste, food rescue, food donation	
LaNZ	
Food waste is happening in New Zealand like other countries.	
Perspective emphasis	
The students will know about the amount of food waste which happens in everyday life.	
Specific knowledge learning intentions	
The students will develop understanding that people waste food while there are so many hungry people in the world.	
Process skills Intentions	Key competency/ cultural competency reinforcement
Indicate the process emphasis	
It involves reflection by the students to draw on their own knowledge and	

<p>allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions The students will learn that there is so much food wasted in a small town like Rotorua while there are so many people in need of food.</p>	<p>The key competency of ‘Thinking’ is involved as students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>Food rescue volunteer</p>
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Lesson 14- Ace the Waste

Class/ curriculum level	Teaching, learning and management
Year 7. Curriculum level 4	(Create and Share phase of teacher directed Guided-Inquiry). The students will prepare a mind map/poster/brochure/about reducing food waste based on their understanding about food waste.
Wider topic Food waste	
Selected context and setting/s XXX School. 45 mins.	The students can also demonstrate their understanding of the food waste and reducing it through any other mean like a morning assembly presentation, a big collage prepared by everyone.
Focus question What are the various ways through which people can reduce food waste?	(Evaluate phase of Guided-Inquiry) The students will complete ‘L’ component of the KWL chart. The students will reflect about the contents and the process of learning about food waste.
Knowledge/ Information Intentions involve	
NZC Achievement Objective The students will understand how people can participate individually and collectively in response to community challenges.	
Key concepts/ Ideas Ace the waste	
LaNZ Food waste is happening in New Zealand like other countries.	
Perspective emphasis The students will demonstrate the ways to reduce food waste.	
Specific knowledge learning intentions The students will learn about the ways to reduce food waste.	
Process skills Intentions <i>Indicate the process emphasis</i>	Key competency/ cultural competency reinforcement

<p>It involves reflection by the students to draw on their own knowledge and allowing them to apply it to new experiences.</p> <p>Specific skills process learning intentions</p> <p>The students learn the skill of presenting their ideas about reducing food waste.</p>	<p>The key competency of ‘Thinking’ is involved as students will make sense of the experience involved.</p> <p>Key resource/s teaching materials</p> <p>A sheet of paper</p>
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Appendix L: Worksheets

Worksheet Lesson 1- Food Waste Audit in the Classroom

Name - Date-

How much food did we waste in a day from our lunch boxes? _____

- If we wasted the same amount of food every day for a week how much would that weigh?
(Multiple times 5)
-

- If we wasted the same amount of food every day for a term how much would that weigh?
(Multiple times 10)
-

- If we wasted the same amount of food every day for a school year how much would that weigh? *(Multiple times 4)*
-

- If every class wasted the same amount how much would our whole school waste in a year?
(Multiple times the number of classrooms in the school)
-

- So, on an average, each student wastes about how much food in a year? *(Divide by the total number of students in the school)*
-

Worksheet Lesson 2- KWL activity about food waste

Name - _____ Date- _____ Topic _____

K What I Know	W What I want to know	L What I learned

Worksheet Lesson 3- Scale of food waste globally and in New Zealand

Name _____ Date- _____

This is not a test. Answer whatever you can remember from the videos.

Video 1

1. Average Kiwi family throws _____ trolleys full of food in a year.
2. Almost _____ of the food waste is by the households in New Zealand.
3. The most discarded/wasted food in New Zealand is _____.
4. The amount of food wasted in New Zealand is enough to feed every single school child in New Zealand lunch for _____ years.

Video 2

1. In the world, every year _____ of the food produced is wasted.

Worksheet Lesson 4- Edible/potentially edible/inedible parts of fruit and vegetables

Name- _____ date- _____

Fruit/vegetable	Edible part	Potentially edible part	Inedible part

Worksheet Lesson 5- Effects of Food Waste on our Environment

Name- _____ Date- _____

Please tick the correct option after watching-

Video 1

1. Which of these is a greenhouse gas-
 Methane oxygen
2. Greenhouse gases, in the right quantity, are good for the environment.
 true false
3. Too much greenhouse gas in the Earth's atmosphere causes the Earth's temperature to
 become warmer become cooler

Video 2

4. Food which is rotting in landfills produces a harmful greenhouse gas called-
 methane carbon dioxide
5. Food waste is harming our environment by raising the temperature of the Earth-
 true false

Draw any harmful effect that you can think, of food waste, which is rotting in the landfills, on our environment.

Worksheet Lesson 6- Effect of Global Warming on New Zealand and the town where the school is situated.

Name- _____ Date- _____

This is not a test. Please answer these after watching the videos.

Q 1. Do you think ‘Global Warming’ will have an effect on New Zealand also?

1. Yes 2. No

Q 2. If you have answered yes in the first question, then can you put a tick on the effects of the ‘Global Warming’ on New Zealand.

- | | |
|----------------------------|--------------------------|
| 1. Rise in sea water level | <input type="checkbox"/> |
| 2. Fall in sea water level | <input type="checkbox"/> |
| 3. Droughts | <input type="checkbox"/> |
| 4. Excess of rainfall | <input type="checkbox"/> |
| 5. Melting of glaciers | <input type="checkbox"/> |

Q 3. Will XXX (this town) also be affected by ‘Global Warming’?

1. Yes 2. No

Q 4. If you have answered yes for question 3 then write what effects will ‘Global Warming’ have on XXX (this town).

Worksheet Lesson 7- Journey of Food From Farm to Table.

Name - _____ Date- _____

This is not a test. Please answer the following after watching –

Video 1

1. The carrot leaves can also be eaten after cooking them.
a. True b. False

2. Big machines are used to grow carrots on large farms.
a. False b. True

Video 2

3. Growing banana fruits are covered with plastic sheet to protect them.
a. True b. False

Video 3

4. Broccoli is picked by hands.
a. True b. False

5. Broccoli travels through lots of machines before it reaches the supermarkets to be sold.
a. True b. False

Video 4

6. Mushrooms are not washed before packaging as they are very delicate.
a. True b. False

Video 5

7. Bread is made in factories which are
a. small b. big

8. Many processes and machines are used to prepare bread for us.
a. True b. False

Worksheet Lesson 9- Imperfect looking fruit and vegetables

Name-_____ Date-_____

Please draw any one fruit or vegetable of your choice.

Now please draw the same fruit or vegetable in its imperfect shape.

Q. If you have a choice to buy, which fruits or vegetables would you buy- (tick one)

1. Perfect looking 2. Imperfect looking

Q. Why? Can you give some reason?

Worksheet Lesson 10- Food labels

Name - _____ Date- _____

Please put a tick in the right box for the correct food label for that food item.

Food	'Use by'	'Best by'
Milk		
Meat		
Seafood		
Banana		
Carrot		
Bread		
Eggs		
Ice cream		
Potatoes		
Carrots		

Worksheet Lesson 11- Virtual Online Grocery Shopping

Names - _____ Date- _____

Your group has been allotted 100 dollars to do some grocery shopping for a family of five members. You will do online virtual grocery shopping from

<https://www.paknsave.co.nz/shop-online/> or <https://www.ishopnewworld.co.nz/> or <https://shop.countdown.co.nz/>

You must include these 5 items in your shopping. Rest 5 items can be chosen by you.

Food item	Cost	Quantity
Bread		
Milk		
Eggs		
Bananas		
Meat		

Worksheet Lesson 12- Composting Food Waste

Name- _____ Date- _____

This is not a test. Write whatever you remember from your viewing of the videos.

Q. What goes in a compost bin and what does not?

Choose from the following list of items and place them in the right column:

vegetables, grass, meat scraps, cheese, leaves, bread, tea bags, fruits, fish, onion peels, glossy paper, cooked rice, crushed eggshells, used paper towels.

Do put in your compost	Don't put in your compost

Q. Do you think composting is good for the environment? Choose one answer-

- a. yes b. no

Q. Can you give some reason for choosing your answer-

Appendix M: Students' Posters

Food Waste

By Amy

What is Food waste?

Food waste is [redacted] wasting or throwing away food that you don't want to eat, or you have too much food.

Rubbish BIN

I feel rejected!

WAHHH!

Everyone is so CRUEL!

Do you know that if you throw food into the dump the water in the fruit mixes with everything else, and this creates a toxic liquid called Leachate. This seeps into the [redacted] ground and gets into our water.

Ugly, misshapen food is actually perfectly fine on the inside, it just looks really UGLY.

Using composting will turn your scraps into soil, that is great for growing food things in.

Don't buy too much food!

Food waste

VS

125 is the amount
of waste that we are
producing every day. Almost all of
us know so that means
metaphorically, we all are shooting ourselves
in the foot

$$\boxed{802} = \circlearrowleft \circlearrowright =$$





Food Waste!

To stop foodwaste you or your family could start composting.

Composting is good for the environment. It also reduces the green that gets put in the landfill.

When foodwaste is in the landfill it produces terrible gases such as Methane and Leachate. They contribute to global warming.

You can compost:

- animal manure
- grass clippings
- vegetables
- fruit
- paper

You can not compost:

- meat
- dairy
- fish
- glossy paper
- oil

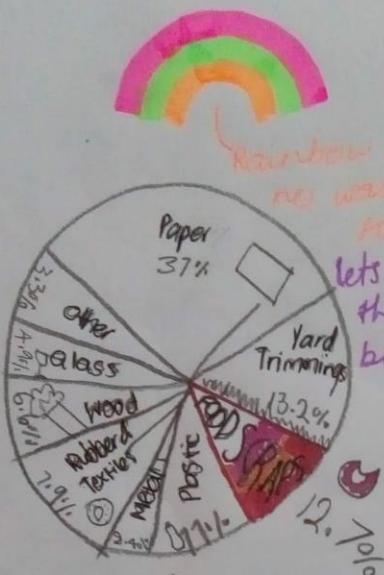


fun fact

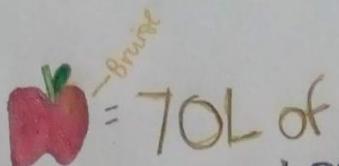
One child wastes
6Kgs of food waste
a term.



LOVE FOOD HATE WASTE!

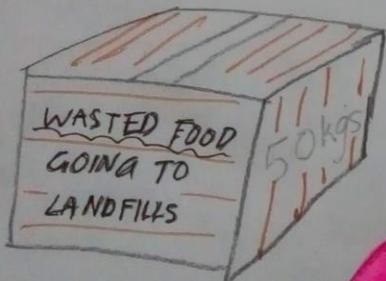


Rainbow of no wasted food
lets make the rainbow bigger!



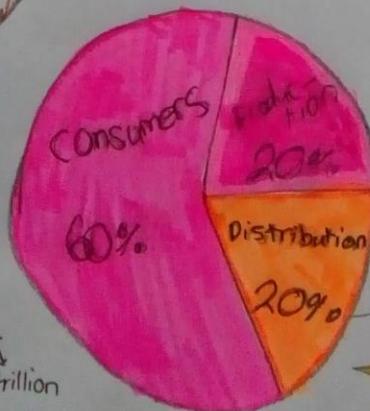
= 70L of water

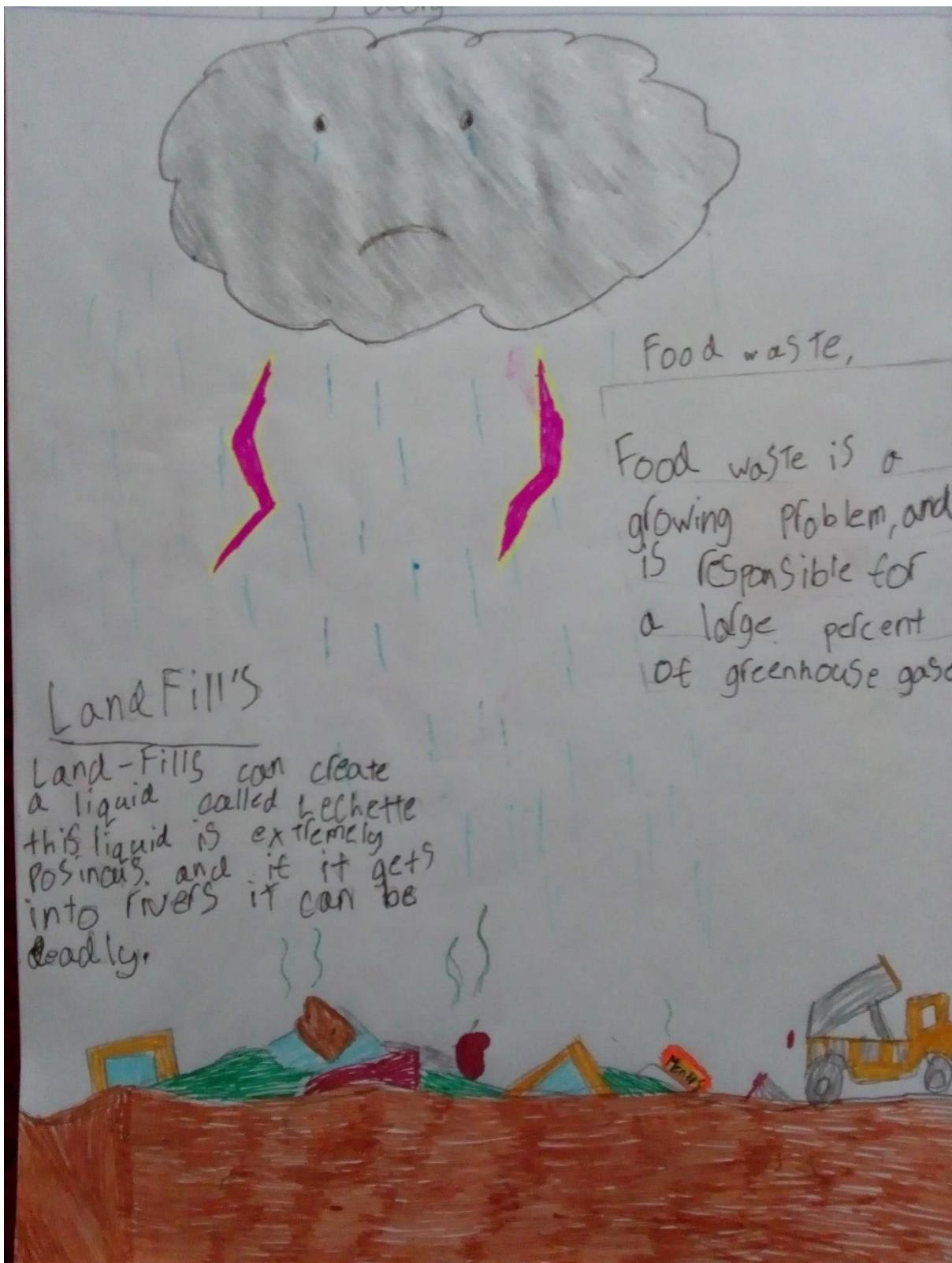
(Technically wasted just because of 1 bruise... NOT COOL)



1.3 billion tons
are WASTED
EVERY YEAR

This amounts to US 1 trillion
dollars (15102550000 NZD) of
wasted or lost food.





Appendix N: Students' Worksheets

Lesson 1 worksheet

Name - Harper

Date - 6/5/19

How much food did we waste in a day from our lunch boxes? 1kg

- If we wasted the same amount of food every day for a week how much would that weigh? *Multiple times 5*

5kg per week

- If we wasted the same amount of food every day for a term how much would that weigh? *Multiple times 10*

50kg per term

- If we wasted the same amount of food every day for a school year how much would that weigh?
Multiple times 4

200kg per year

- If every class wasted the same amount how much would our whole school waste in a year? *Multiple times the number of classrooms in the school*

4600kg

- So, on an average, each student wastes about how much food in a year? *Divide by the total number of students in the school*

6.7kg per student

Scanned by TapScanner

Worksheet lesson 9

Name- Sophie

Date- 23/5/19

Please draw any one fruit or vegetable of your choice.

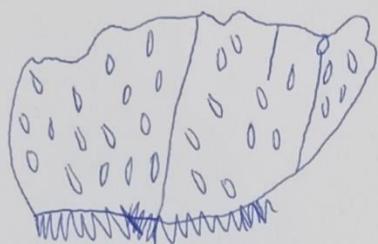


<- Watermelon



strawberry

Now please draw the same fruit or vegetable in its imperfect shape.



If you have a choice to buy, which fruits or vegetables would you buy- (tick one)

1. Perfect looking 2. Funny looking

Why? Can you give some reason?

I would buy both
because they are
both perfectly good on
the inside. They just
look different.

Light bulb

Caesar Salad \$3.99 x1
 Carrot \$1.39 ~~\$12.49~~ \$6.49 ~~x2 pack~~
 cheese \$12.49 ~~\$6.49~~ x1 block x1
 grated

Worksheet Lesson 11

Names - Brenda & Grace

Date - 28.5.19

Total = \$101.34c

Your group has been allotted 100 dollars to do some grocery shopping for a family of five members.

You will do online virtual grocery shopping from <https://www.paknsave.co.nz/shop-online/> or <https://www.ishopnewworld.co.nz/> or <https://shop.countdown.co.nz/>

You must include these 5 items in your shopping. Rest 5 items can be chosen by you.



Food item	Cost	Quantity
Bread	\$1.25	2 bread ✓
Milk	\$6.47	2 milk ✓
Eggs	\$5.09	16 pack eggs ✓
Bananas	\$1.99	1x banana bunch
Meat (Chicken)	\$13.99	Beef mince x1 Pork chicken breast x1
Juice (Apple)	\$5	4x 1L juice
Coco Pops (Milk/Cereal)	\$4.79	1x small
Milo (Powder)	\$3.99	1x small
Tim Tams	\$3.79	1x choc
Cabbage	\$1.99 green \$2.59 purple	2x green & purple
Broccoli	\$1.89	1x 90g ✓
Coffee	\$2.49	1x 90g ✓
Apples	90c	x3
Water (24 pack)	\$9.99	x1

Laundry Powder \$16.99 ~~x1~~ - 14.38
 Wheelies \$1.99 x1 13.91 ~~1.94~~ ~~bag fees~~ ~~2~~

Sauces \$3.69 x1
 Ice Cream \$5.99 x1 bag fees

Worksheet Lesson 12

Name- Olivia Date- 5/6/19

This is not a test. Write whatever you remember from watching the videos.

Q. What goes in a compost bin and what does not?

Choose from the following list of items and place them in the right column:

vegetables, grass, meat scraps, cheese, leaves, bread, tea bags, fruits, fish, onion peels, glossy paper, cooked rice, crushed egg shells, used paper towels.

Do put in your compost	Don't put in your compost
grass	meat scraps
leaves	fish
tea bags	fish
bread	cheese
fruits	glossy paper
Vegetable	
onion peels	
cooked rice	
used paper towels	

Q. Do you think composting is good for the environment? Choose one answer-

- a. yes b. no

Q. Can you give some reason for choosing your answer-

Because it reduces green house gas and it helps making global warming NOT as bad.
It helps the plants grow and it's a good thing to put in your garden.

