



Article

# The transformative potential of textbooks: Food waste knowledge and pedagogical text styles in Finnish Home Economics, Geography, and Biology textbooks

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## Abstract

Education is recognized as crucial in addressing unsustainable practices, such as food waste. One of the aims of interdisciplinary food education in basic education is to promote sustainable food waste behavior, which can be promoted by transformative learning. This study examined how food waste is addressed in nine Finnish basic education textbooks. The content related to food waste and the pedagogical style of the texts were analyzed from home economics, biology, and geography textbooks designed for secondary level education (grades 7–9, age 13–16). The results were analysed to assess their potential to promote transformative learning. All of the textbooks approached the topic of food waste from the perspective of their own subject, and none presented it as an interdisciplinary phenomenon. Home economics textbooks focused on students' perspectives, emphasizing food waste reduction and waste sorting. Geography



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textbooks frequently explored the topic in the context of the food supply chain or at a global level, while biology textbooks primarily addressed the sorting of food waste. The textbooks primarily used a neutral text style focusing on information transmission. In some contexts, a persuasive style was employed to encourage critical thinking and action. The participative style, which encourages active student engagement, was utilized the least in all textbooks, and primarily for exercises. By integrating learning-supportive text styles (such as participative and persuasive), including student tasks related to food waste, and fostering an interdisciplinary understanding of food waste, textbooks have the potential to transform student learning and engagement in sustainable food practices.

**Keywords:** food waste, textbook research, transformative learning, food education, sustainability

## Introduction

The global agri-food systems produce more than one-third of greenhouse gas (GHG) emissions (Tubiello et al., 2022). Furthermore, one-third of all food produced in the food supply chain ends up as food waste (FAO, 2019; Gustavsson et al., 2011; UNEP, 2021). Food waste weakens the sustainability of the food system, causing environmental burdens, inequality in food distribution, and financial losses for various actors in the food chain (Mason & Lang, 2017). In Europe, approximately over half of all food waste is caused by households (Eurostat, 2023; Stenmarck et al., 2016), and education is suggested as one of the key means to reduce consumer-related food waste (e.g., Fraj-Andrés et al., 2023; Ripple et al., 2017).

The goal of sustainable food education is to achieve long-lasting positive changes in students' knowledge (both factual/technical and practical skills) and values and attitudes related to food (Koch, 2016), which manifest in actions such as reducing meat consumption and minimizing food waste. Sustainable food education also encompasses other aspects, such as food safety and availability, food security, sustainability of the food system, and health (Contento, 2015), and it aims to guide students toward sustainable lifestyles and critical thinking through transformative learning. Food education is considered central in educating and empowering children and young people today, as it aims to reduce food waste and promote sustainability.

Halving food waste by 2030 is part of the United Nations' (UN) Sustainable Development Agenda 2030 goals. UNESCO strives to achieve the UN's goals of sustainable development through Education for Sustainable Development (ESD), particularly emphasizing the significance of transformative learning (UNESCO, 2014; 2018). The theory of transformative learning was defined in the 1970s by Mezirow, an adult educationalist (Kitchenham, 2008). Mezirow describes that transformative learning refers to the process in which the learner questions worldviews through reflection (Mezirow, 1991). Later, the theory has been developed in various directions, and especially during the last decade, many sustainability education studies have adopted it as a prerequisite for addressing sustainability challenges (see Rodríguez Aboytes & Barth, 2020). Sterling (2011) suggests that transformative learning is the deepest level of

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learning, which generates epistemic learning and thus a genuine paradigm shift towards sustainability.

Previous research on sustainability issues has addressed food waste, however, the emphasis has been on measuring for example how much waste is created by households (e.g., Silvennoinen et al., 2022) and finding ways to reduce household food waste as well as understanding the reasons behind it (e.g., Principato et al., 2021; Simões et al., 2022; van der Werf et al., 2021). There have also been pedagogical studies concerning teachers' classroom practices related to food and waste (e.g., Elorinne et al., 2020; Redman & Redman, 2014) and studies from interventions aimed at influencing students' intentions to reduce food waste (e.g., Nikravech et al., 2022; Prescott et al., 2019). However, food waste has not been examined in the field of textbook research, although other sustainability goals of textbooks have been studied (e.g., Biström & Lundström, 2021; Chou, 2021).

In this study, we focused on what kinds of knowledge about food waste are provided through home economics (HE), geography (GE), and biology (BI) textbooks in the Finnish education context. Sustainable food education is provided mainly through home economics education (e.g., Gisslevik et al., 2018), even though the topic crosses school subject boundaries. For example, geography (e.g. sustainable lifestyle and sustainable use of natural resources, food system) and biology (e.g. food plants, starch, animals as food) also cover food-related issues. The present research aimed to understand sustainable food education as an interdisciplinary phenomenon by studying three school subjects. Textbooks are used widely in Finland for teaching and learning subjects such as home economics, geography, and biology (Kärnä et al., 2012; Venäläinen, 2015). Thus, textbooks offer valuable research sources for studying current themes, such as food waste, in basic education.

The theoretical framework of transformative learning, which argues that a pedagogical approach emphasizing transformation is necessary to bring about significant changes in human behavior (e.g., Mezirow, 1990), underpins our research. Typically, this transformative pedagogy calls for learner-centered features, like real-life learning topics, collaborative and action-oriented projects, and problem-based learning as well as reflexivity and interdisciplinarity (e.g., Bell, 2016; Sterling et al., 2018). Thus, our study aimed to examine how sustainable food education is conceptualized in Finnish textbooks, especially in the context of food waste, and how content knowledge and pedagogical styles facilitate the transition towards a more sustainable future by altering the mindset and enhancing the sustainability skills of children and young people.

## Sustainable food and waste education

Despite education being highlighted as a central means to reduce food waste there is no previous textbook research on the food waste phenomenon, as argued above. Notably, scientific research on food waste

emerged in the early 2010s and the topic remains quite novel in the field of sustainable food education (e.g., Elorinne et al., 2020; Prescott et al., 2019). However, there are a few pedagogical studies concerning food and waste (Elorinne et al., 2020; Redman & Redman, 2014). Elorinne et al. (2020) explored the attitudes, personal practices, and educational approaches of Finnish school teachers pertaining to food waste. Their study indicated that teachers who have a sense of wide personal responsibility concerning food waste were more likely to incorporate the subject into their pedagogical approaches. Redman and Redman's (2014) study focusing on primary and secondary education teachers (n=346) explored declarative (i.e. facts, technical information), procedural (i.e. knowing-how, skills), effectiveness (i.e. understanding of impacts/efficacy), and social types (i.e. social expectations) of knowledge concerning an individual's engagement in sustainable food and waste practices within an educational setting. Their study showed that even if an individual has a high level of declarative knowledge, this alone does not predict an increase in commitment to sustainable behavior. Instead, procedural (the practical execution of sustainable actions) and social knowledge (the influence of societal factors on sustainable behavior) emerged to be significant predictors of sustainable food behavior.

### **Promoting sustainable behavior through textbooks**

The existing body of research has indicated that textbooks guide the pedagogical content and teaching methods employed by educators during lessons, albeit with some variation in the scope and degree of this influence among educators (Brown, 2009; Harjanne et al., 2017; Karvonen et al., 2018). In addition, textbooks themselves have an inherent value as a pedagogical tool: they can be used as self-study materials and as materials for homeschooling. Previous sustainability-related textbook studies have focused on textbooks' knowledge construction and guiding activities to facilitating behavior change towards responsible behavior (e.g., Andersen, 2018; Nguyen, 2019). These studies have shown that textbook contents and tasks may not systematically support sustainable behavior. Nguyen's (2019) research revealed that Vietnamese geography textbooks conveyed an instrumental approach to promoting sustainable development. The contents and approaches were based mainly on description and memorization, while the exercises and questions were primarily centered around memorization, rote learning, and reproduction. In Andersen's (2018) study, it was noted that tasks related to sustainability in Luxembourgish science textbooks did not frequently involve action-based or task-based learning. The textbooks he examined contained limited content related to sustainability, frequently with an indirect relation to the concept of sustainability.

Studies have also noted that textbooks' sustainability-related contents are not comprehensive. Biström and Lundström (2021) found that Swedish biology and geography textbooks lacked comprehensive coverage of all aspects of sustainable development. Furthermore, the contents oversimplified complex sustainability-

related themes and overlooked significant conflicts that are crucial for understanding the challenges associated with achieving sustainability and taking effective action. Chou (2021) discovered that in Taiwanese science textbooks, global sustainability issues were only addressed within the current time and local context, and from a limited viewpoint. Additionally, in the textbooks of various subjects, sustainability was confined to the content of the respective subjects. In the following, we review the literature on pedagogical textbook styles and examine how that approach can be applied to the study of food waste in textbooks.

### **Enhancing learning through the pedagogical style of textbooks**

Pedagogical textbook research is largely based on the idea that diverse pedagogical choices (e.g. styles and format and features of exercises) in textbooks guide learning in different ways. In studies related to food and the environment, the way textbooks influence learning has been examined, for instance, through the pedagogical style (e.g., Hokkanen & Kosonen, 2013; El Moussaouy et al., 2014). In those studies, the framework used for analyzing the pedagogical styles used in textbooks comprises four text style categories: neutral, injunctive, persuasive, and participative. While all four styles deliver information, they differ in how they guide and motivate students to learn and reflect on learning topics and in how they problematize them (Hokkanen & Kosonen, 2013). In their studies, El Moussaouy et al. (2014) and Hokkanen and Kosonen (2013) have observed that textbooks mainly utilize a neutral style, although depending on the research, injunctive and persuasive styles were also widely used.

Various teaching methods, such as critical reflection, can be viewed as facilitating transformative learning. As Mezirow (1990) has argued, transformative learning is characterized by the act of reflecting on our beliefs and reevaluating the assumptions upon which they are built (also Sterling et. al, 2018). Promoting students' knowledge construction can be achieved by adding a participative text style to textbooks. This style guides students to reflect on their actions and seek justifications. Additionally, favoring a persuasive style encourages students to acquire information and validate the actions presented as beneficial in textbooks (Hokkanen & Kosonen, 2013). Participative tasks are particularly essential as they involve retrieving information, engaging in activities, applying knowledge, collaborating, and self-reflecting on one's life and choices. Text written in a neutral style provides passive knowledge without promoting action or reflection, whereas an injunctive style gives commands or instruction without reasoning (Hokkanen & Kosonen, 2013). However, neutral information also plays a crucial role in the construction of new knowledge. When students initially have limited foundational knowledge, previous knowledge can also constrain the building of new knowledge (Bransford et al., 1999).

## Research questions

The Finnish basic education curriculum emphasizes sustainability and the responsibility of all subjects and teachers to teach it (FNBE, 2014). However, in secondary school (grades 7–9, age 13–16) practices related to sustainable food education and food waste are mainly implemented within home economics (Elorinne et al., 2020; Haapala et al., 2014). Yet, the topic of sustainable food education is related to geography and biology in the national curriculum, in which both subjects emphasize the promotion of a sustainable future, lifestyle and sustainable consumption, and responsible citizenship (FNBE, 2014). We therefore chose these three subject areas to examine the phenomenon of food waste in basic education textbooks. We focused on analyzing and comparing the content and the pedagogical styles in which knowledge is presented and constructed within these textbooks. The research questions were:

1. What kinds of information about food waste do home economics, geography, and biology textbooks contain?
2. What pedagogical styles are used in home economics, geography, and biology textbooks when discussing issues related to food waste?

## Methodology

The textbooks were selected from textbook publishers with the widest circulation. In data collection, good scientific practice (Finnish Advisory Board on Research Integrity (TENK), 2012) was followed: detailed information was provided to textbook publishers about how the textbooks would be used. Initially, 15 textbooks were screened, from which those that in some way addressed food waste were selected for analysis. The resulting research data consisted of nine textbooks, three per subject (see Table 1). One of the selected home economics textbooks was an e-book (Enjoy everyday life), which was chosen because, during the data acquisition, there were only two printed home economics textbooks available on the market. All of the textbooks were published after the last curriculum reform (FNBE, 2014).

**Table 1.** Description of the research data and the abbreviations used

Subject	Title and year	Chapters where FW appeared	Abbreviation
Home economics	“Enjoy everyday life” (2018)	3	HE1
	“Home economics skills” (2016)	5	HE2
	“Luck” (2015)	4	HE3
Geography	“Geoid. Requirements for life” 2017	1	GE1
	“Earth. World to the home” (2015)	1	GE2
	“Earth. The planet of life” (2015)	1	GE3

Biology	“Bud. Forest” (2018)	1	BI1
	“Code. Nature” (2017)	1	BI2
	“Code. Life” (2016)	1	BI3

## Analysis

In the first phase, the data was analyzed using data-driven content analysis. The criteria for searching for information related to food waste from the textbooks were as follows: the concept of food waste is used, or the text refers to food that ends up or could end up being discarded (such as leftovers, surplus food, or avoiding food wastage). Based on this close reading of food waste information, the data were subsequently categorized into three categories and labeled as 1) *technical information*, referring to information on what food waste is, how much of it there is, what causes it, and which types of food usually end up as waste; 2) *information related to reducing food waste*, i.e. highlighting the importance of food waste reduction and giving examples of it, and 3) *information related to sorting food waste*, including instructions for sorting food waste, presenting the sorting or composting of biowaste as beneficial, and generation of food waste is questioned when sorting instructions is given.

In the next phase, the content analysis shifted towards a theory-driven approach, where the food waste contents were examined from the perspective of their pedagogical style (see below). The framework for pedagogical style analysis (see Table 2) was developed by utilizing previous textbook research (El Moussaouy et al., 2014; Hokkanen & Kosonen, 2013). In the analysis, text styles were classified into four different pedagogical text styles: neutral, injunctive, persuasive, and participative.

**Table 2.** Examples of pedagogical styles in the text and tasks within the data

Pedagogical style	Style description:	Example
Neutral	<p><b>Text:</b> Sharing information. Knowledge is presented in the passive voice, providing an account of a phenomenon or action without containing guidance for action.</p> <p><b>Task:</b> Simple problem. Simple answers that are easy to find in the book. Does not require justification or reflection.</p>	“When food is stored carefully and according to instructions, food waste decreases and the food is safe to eat.” (HE3, p. 20)
Injunctive	<p><b>Text:</b> Directing action. Unsubstantiated or minimally justified guiding or commanding action.</p> <p><b>Task:</b> Command to act or do something in a certain way, without justification or providing the rationale behind the action.</p>	“Make use of leftover food – do not throw away food.” (HE2, p. 282)
Persuasive	<p><b>Text:</b> Guiding action. Text persuades to act in a specific way and/or convincingly justifies the significance of the action.</p>	“Food production requires a lot of natural resources, money, and work, so it is

**Task:** Typically problem-based, usually leads to a specific solution. Often involves “why” questions with readily available explanations

important to buy only as much food as you can prepare and eat. It is also worth storing food properly.” (HE2, p. 28)

Participative **Text:** Guiding action. Multiple possible courses of action are recommended, from which the student can choose, or the student is guided to explore different approaches themselves.

**Task:** Problem/phenomenon-based, where the problem is presented or discoverable by the student and it is open to discussion. The solution may require seeking information outside the textbook, being proactive, applying information, collaborating, or reflecting on one's own life and choices.

“In teams, create a plan to ensure that all people in the world can be fed in the future.” (GE2, p. 79)

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## Results

In the following, we discuss what food waste information the textbooks contained and what pedagogical styles the textbooks used. The results begin by presenting the information contained in the textbooks according to the main categories obtained in the text analysis (see Table 3). After that, we examine the various pedagogical styles employed in the texts within the textbooks and the exercises provided in the textbooks.

### Textbooks’ food waste information

The information on food waste contained in the textbooks was classified as ‘Technical information, ‘Information on how to reduce food waste’, and ‘Information on sorting food waste’ (see Table 3). All of the home economics textbooks along with one geography textbook and one biology textbook highlighted the importance of minimizing food waste as a major objective. The textbooks of the three subject areas approached the topic from the perspective of their discipline (Table 3): home economics textbooks (particularly HE1 and HE3) covered the topic most comprehensively, geography textbooks primarily focused on the context of reducing food waste, and biology textbooks emphasized the sorting of food waste.

The geography and biology textbooks as well as one home economics textbook did not explicitly define food waste but used expressions such as: “Do not waste food by throwing it away.” (HE2, p. 28) or “You should also avoid buying too much food, as there is a risk of it spoiling and having to be thrown away.” (GE1, p. 115)

The textbooks primarily focused on presenting the amount of food waste and the reasons for its occurrence through technical information. The textbooks discussed the issue of food waste by focusing on households,



and the information they provided was consistent with what has been published in the research literature (e.g., Silvennoinen et al., 2022). In geography textbooks the quantity of food waste was presented from the perspective of the production chain: “At some point in the production chain, 25% of food deteriorates in terms of energy and 32% in weight” (GE2, p. 74). Furthermore, in geography textbooks, the reasons for food waste were also presented from a global and entire production chain perspective, whereas in home economics textbooks the focus was solely on the household perspective.

Geography: In Europe and North America, food is produced in excess of actual demand. Certain food items, such as eggs, are difficult to store for long periods of time. As a result, surplus food has to be sent to landfill or sold at very low prices. (GE1, p. 115)

Home economics: In Finnish households, approximately 23 kilograms of food per person are wasted each year. The most common reasons for neglecting composting are lack of time, indifference, and lack of planning. (HE3, p. 40).

Food waste reduction was especially addressed by geography and home economics textbooks. Two home economics textbooks presented the most versatile ways to reduce food waste, although all home economics and geography textbooks presented at least two ways of reducing food waste. Textbooks mainly focused on the importance of planning purchases, such as creating shopping lists or determining the right amount of food to buy, to prevent food waste. However, in home economics textbooks, actions related to home food storage, usage order, reusing leftovers, meal planning, and appropriate portion sizes were also highlighted.

Home economics: Leftover food can be used to make delicious treats, such as omelets, vegetable puree soups, ham casseroles, fried potatoes with sausage and egg, and French toast. (HE3, p. 40)

**Table 3.** Technical information, information of reducing and sorting food waste in textbooks

Food waste (FW) information		HE1	HE2	HE3	GE1	GE2	GE3	BI1	BI2	BI3
Technical information	FW term in use	x		x		x				
	FW term is defined	x								
	Amount of FW	x		x		x				x
	Most wasted foods					x				
	Reasons for FW are presented	x		x	x					
Information related to reducing FW	FW reduction is presented as important	x	x	x	x	x	x			x
	Ways to reduce FW	x	x	x	x	x				

are presented

Information related to sorting FW	Instructions for sorting FW are given	x	x	x		x	x	x
	Sorting or composting of biowaste is presented as beneficial	x		x		x	x	
	Generation of FW is questioned when sorting instructions are given							x

In addition to consumer-oriented actions, one geography textbook (GE2) also presented food waste reduction measures from the perspective of the food chain, including maintaining food hygiene in storage and improving the procurement practices of grocery stores:

Waste less food:

- Improve cleanliness to prevent microbes from spoiling food
- Prevent pests from accessing storage areas
- Order only as many products as can be sold in stores
- Avoid throwing food away (GE2, p. 75)

Geography textbooks, along with one biology textbook, commonly emphasize the significance of reducing food waste in a broader context, such as global or food chain viewpoints. In these cases, the textbooks typically addressed a different issue, such as food security, in which the reduction of food waste was mentioned.

Geography: [...] by reducing food waste, there can be food for everyone (GE2, s. 62)

Biology: However, it is not advisable to discard food, as this leads to unnecessary consumption of natural resources for food production. (BI3, p. 148)

In home economics textbooks, the advantages of reducing food waste were emphasized particularly from the viewpoint of students, such as the connection between food waste reduction and saving money.

Save on food expenses. [...] -Store food properly to prevent it from spoiling (HE2, p. 282)

The home economics textbooks further highlighted waste reduction not only as a practical skill (e.g., saving money) but also a reflection of sophisticated culinary culture:

Good manners, respect for food, and responsible choices are part of a sophisticated culinary culture. These civilized manners are evident in various ways, one of which is minimizing food waste. (HE3, p. 104)

However, there were also sections in home economics textbooks where the reduction of food waste was

justified on a broader scale than just from the household perspective. Unlike in geography and biology textbooks, in these cases, the impacts of food waste, such as on the food chain, were not examined in further detail.

A lot of different resources are used in food production, transportation, and storage, which constitute the food chain. Do not create waste by throwing food into the trash. (HE2, p. 28)

Information related to sorting waste food was addressed in all home economics and biology textbooks. In all of these textbooks, instructions on what can be sorted into biowaste or compost were given. In the context of sorting-related information, the generation of food waste was not usually questioned, except in one (biology) textbook where a stance was taken regarding the sorting of leftover food, emphasizing that food should not be wasted. However, most textbooks focused on highlighting the importance of sorting or composting biowaste.

### Pedagogical styles

Our second research question sought to identify what pedagogical styles appeared in the texts and exercises of the textbooks. Based on the theory-driven analysis, text styles were divided into four categories. Table 4 illustrates the pedagogical styles in the text and exercises used in the textbooks, based on the categories formed in the first stage of analysis (Table 4).

In the textbooks, technical information was typically presented neutrally rather than guiding the reader toward action or reflection (see Table 4).

In Finland, approximately 120-160 million kilograms of food are thrown away each year, which is equivalent to 20-30 kilograms per person, resulting in a total value of 500 million euros. (HE1, 3.3.1.)

**Table 4.** Pedagogical styles and their frequency in text and student tasks in textbooks

Food waste information or tasks	pedagogical style	HE1	HE2	HE3	GE1	GE2	GE3	BI1	BI2	BI3
	Neutral	xxx		x		x				x
Technical information	Injunctive									
	Persuasive									
	Participative									
Information related to reducing FW	Neutral	x	x	x		xx				x
	Injunctive	x	xxx	xxx	x					
	Persuasive		xx	x	x		x			
	Participative		x							

Information related to sorting FW	Neutral	x	x	x			x	x	x
	Injunctive	x	x	x					
	Persuasive								
	Participative								
Tasks	Neutral								
	Injunctive								
	Persuasive			x					
	Participative	x	x		x	x	x		x

Note: “x” indicates rare, “xx” moderate, and “xxx” predominant utilization of the style.

Food waste reduction was addressed neutrally in most textbooks. An injunctive text style, which guides action without providing justification, was also employed in home economics textbooks. On the other hand, home economics textbooks also utilized to some extent a persuasive style where the justifications for actions were visible. The participative style was used less in all textbooks, except for one textbook (HE2).

Injunctive style: Put an appropriate amount of food on your plate (GE1, p. 115)

Persuasive style: You can reduce your water footprint through your consumption choices. Prefer plant-based over meat products and avoid wasting food. (GE3, p. 33)

Participative style: See more tips [on reuse of leftover food] on the ‘Enjoy your meal ‘[in Finnish: ‘Saa syödä hyvin’] website (HE2, p. 283)

When discussing the sorting of food waste, all of the home economics and biology textbooks used a neutral style when explaining that food scraps belong to compost or organic (bio) waste.

Biowaste includes organic compostable waste, such as food scraps (HE3, p. 42)

Home economics textbooks were the only ones that directed the sorting of food scraps. When guiding food sorting actions, the textbooks employed an injunctive text style and did not provide justification in this context for why sorting would be important.

Remove food scraps from your dishes into the organic waste bin (HE2, p. 31)

The geography and biology textbooks and one home economics textbook (HE1) included several tasks for each theme taught. However, there were only a total of seven tasks related to food waste in the textbooks. In the home economics textbooks, there were fewer exercises or none. Food waste-related tasks were included in six textbooks: all geography textbooks, two home economics textbooks, and one biology textbook. Most of the tasks were participative in style, with one exercise in the home economics textbook being persuasive. The persuasive task required students to seek knowledge about Waste Week (a Finnish campaign to reduce food waste) and other similar environmental campaigns (Energy Saving Week and

Earth Hour) (see Table 5, Item 1). Although the persuasive task required students to seek knowledge and provide justifications, it had a predetermined solution, and therefore it did not involve further application or deeper contemplation of the matter.

Although most tasks were participative in style, they were only indirectly or partially related to food waste. As a result, the tasks did not specifically guide students to reflect on or explore knowledge related to food waste. However, in one of the home economics textbook tasks, the connection to reducing food waste was clearer. In the task, students were guided to plan a meal using leftovers. The task was in a chapter that addressed reducing food waste by repurposing leftovers (see Table 5, Item 2). Although the task challenged students to engage actively and to apply their knowledge, it did not, however, require personal reflection on why it is important to reduce food waste.

Reducing food waste was sometimes presented as one possible answer to a given task. For example, in two geography textbooks (GE2 and GE3) reducing food waste was discernable as one possible answer to the task or one of the sub-questions of the task if students use information from the textbook in their answers (see Table 5, Items 3 & 4). However, even when the tasks challenged the students to seek and apply knowledge, whether the students took food waste into account in their responses depended on their understanding of how food waste is connected to these issues.

One task that utilized a participative style was exemplified by one geography textbook (GE1). This task focused on school meals instead of food waste, but closely addressed content related to food waste. In the task, students were required to search for information outside the textbook by interviewing stakeholders (school kitchen staff) and investigate and determine the amount of food wasted in the school cafeteria as well as its sorting and disposal (see Table 5, Item 5). Additionally, students were guided to consider possible areas for improvement related to school meals and to have a concrete impact by sharing these ideas with the student council.

The remaining tasks in home economics and biology textbooks (see Table 5, Items 6 & 7) were related to sorting food that ended up as waste. In the home economics textbook, students were guided to reflect in groups on the life cycle of a food item all the way to its disposal. The biology textbook mentioned that leftover foods are included in compost. The task required students to deepen their understanding of the composting process and its benefits, as well as to investigate the final disposal of organic waste produced at school, which connects the task to the students' lives. Although both tasks were overall highly participative, in neither task was food waste itself questioned or brought up for consideration.

**Table 5.** Tasks in all three subjects' textbooks

Item	Task
1	Find out what Energy Saving Week, Food Waste Week, and Earth Hour are. What is their purpose, and when are they observed? (HE3, p. 45).
2	Plan a meal (main course and dessert) using leftovers. (HE3, p. 45)
3	Examine Figure 3.15 of the water footprint. a) Which products have the largest water footprint? b) Calculate your water footprint using websites available on the internet. c) Think about the food you've consumed during the day. Which foods contribute the most to your water footprint? Use online water footprint calculators. d) How can you personally influence your water footprint? (GE3, p. 39)
4	Create a plan with your group on how to feed all the people in the world in the future. (GE2, p. 79)
5	School Lunch Project a) Take photos of school lunch servings. b) Take photos of the cafeteria waste bins. How does the sorting work? c) Interview the school kitchen staff. -How much food is wasted at your school? -Where does this food end up? d) How could you improve the school lunch program at your school? Collect ideas and communicate them to the student council. (GE1, p. 117)
6	Food Lifecycle (Group task) Choose a food item and consider its lifecycle. a. What is the product made from – what are its raw materials? b. What natural resources are needed to make the product? c. What stages are required in the product's production before it is sold? d. What happens to the food item after purchase? e. How is the product disposed of? Draw, describe, or cut pictures from magazines to create the lifecycle of the chosen food item. (HE1, 3.6)
7	Composting is worthwhile. In every Finnish household, about half a kilogram of organic waste is generated per day. Organic waste includes, for example, fruit and vegetable peels, food leftovers, coffee grounds, and pet bedding made from wood. a) Find out what else can be put into organic waste. b) Find out how to properly maintain a compost bin to make it work effectively. c) Explain, using biological terms, the basis of composting. d) What are the benefits of composting? e) Find out where the organic waste from your school ends up. (BI2, p. 20)

## Discussion

The environmental impacts of food have reinforced the objectives of sustainable food education in schools, as this is seen as a way to educate children and young people about reducing food waste and promoting

sustainability (e.g., Contento, 2015). The issue of food waste is commonly linked to households, but it is important to recognize that it is a complex problem intertwined with global food systems. Thus, we analysed food waste phenomena within secondary school textbooks from three distinct disciplines – home economics, biology, and geography – that teach the issues of food waste and the sustainability aspects of the food system. In addition, we reflect on the results from a transformative learning perspective, which posits that pedagogy should provide students with tools for critical thinking (e.g., Bell, 2016; Sterling et al., 2018).

The term 'food waste' was only used in two home economics and one geography textbook. In particular, geography and biology textbooks did not address the food waste phenomenon specifically but rather addressed the issue in the global context of the food system. However, the textbooks presented food wastage as a negative phenomenon. The fact that food waste was not recognized as a phenomenon may be because the reduction of food waste has only become a research topic and a political goal in the last decade, and the dissemination of knowledge into textbooks takes time.

Food waste was addressed most comprehensively in the textbooks of home economics compared to geography and biology textbooks, which confirms the findings of previous studies that sustainable food education in basic education primarily takes place during home economics lessons (e.g., Elorinne et al., 2020; Haapala et al., 2014). The textbooks constructed knowledge about food waste based on the curriculum of their subject instead of utilizing an interdisciplinary perspective, which promotes transformative learning (e.g., Sterling et al., 2018). An advantage of interdisciplinarity is that the learner gains knowledge from different disciplines, through which they learn to understand the nature of the phenomenon. For example, understanding the food waste phenomenon requires knowledge of why food waste is an environmental and food security issue and what measures are needed at different stages of the food chain to avoid food waste. Information related to these aspects was found in the researched textbooks: home economics textbooks discussed food waste sorting and reduction from the student's viewpoint, geography textbooks often examined food waste within the context of the food chain or globally, and biology textbooks primarily covered the sorting of waste food. However, none of the textbooks we studied addressed food waste using a phenomenon-based learning approach. When a textbook focuses solely on its own subject, the connection of the matter to broader contexts remains unaddressed. This research finding confirms previous studies (Biström & Lundström, 2021; Chou, 2021; Elorinne et al., 2020) showing that students learn topics in school in a disconnected manner in separate subject lessons rather than through a phenomenon-based approach.

Based on the results, the pedagogical text styles used in the textbooks related to food waste could have better supported transformative learning. In line with previous studies (El Moussaouy et al., 2014;

Hokkanen & Kosonen, 2013), in all textbooks, the most often used text style was neutral, which conveys only information. While in some cases traditional knowledge transmission also has its place, especially when learning new things (Bransford et al., 1999), in sustainable food and waste behavior, neutral technical knowledge provision has not been found to correlate as effectively with behavior in terms of skills and norms (procedural and social knowledge) (e.g., Redman & Redman, 2014). However, especially in the texts of the home economics textbooks, guidance was also provided for practical activities. In those cases, the text style was often injunctive, which does not necessarily encourage students to engage in reflexivity (awareness of the influence of one's own life, actions, and starting points (Sterling et al., 2018). A more systematic persuasive text style that guides and justifies actions was occasionally utilized in the textbooks, mostly in those of home economics. A participative text style that enables reflection and actively engages and involves the student was used the least in the textbooks, and only in the textbooks of home economics.

Generally taken, there were few tasks related to food waste in the textbooks, although their pedagogical style was predominantly participative. However, as food waste or its reduction was not the primary focus of those exercises, they were typically not specifically purposed to increase knowledge about food waste. Even though home economics textbooks covered food waste most comprehensively, not all of them included tasks related to food waste. This may be explained by the fact that in Finland home economics education has traditionally been practical, and teachers often assign practical homework tasks. Each geography textbook contained an exercise related to food waste, whereas only one such exercise was found among the biology textbooks. Overall, the exercises can be expected to promote transformative learning as most of them were project-based and required teamwork, reflexivity, and active participation. These findings differ from what has been found in other sustainability-related textbook studies, where tasks did not involve active participation (Andersen, 2018; Nguyen, 2019).

## Limitations

This study focused solely on Finnish textbooks. However, the results can also be utilized in a broader discussion concerning the transformative potential of textbooks and how this may be enhanced. While the size of the data is relatively small, it is comprehensive within its context: during the data collection phase, no widely circulated textbooks in line with the new Finnish basic education curriculum were available. The pedagogical style framework is not the only approach through which the transformative potential of textbooks can be examined. However, it does provide a tool with which how textbooks create knowledge and guide learning can be systematically examined.



## Conclusions

Textbooks moderately constructed students' understanding of food waste as an environmental and food security problem, and the potential for change was only observed in textbook assignments. The textbooks examined food waste from the perspective of their subject, and their pedagogical text style was primarily informational and written in a neutral style. To promote change in students' food waste behavior, textbooks should construct knowledge of the food waste phenomenon in an interdisciplinary manner. If and when recommendations are made in the textbook, it is necessary to argue for them. It is also necessary to guide students to question their current food waste practices. Textbooks should also include assignments in which food waste reduction is carried out in practice. Our research findings challenge current practices. The subjects taught in the basic education curriculum are differentiated by subject rather than a phenomenon-based approach. In addition, the current basic education curriculum does not include sustainable food education goals, and food waste appears as a marginal phenomenon. For textbooks to support transformative learning, the principles of transformative learning must first be embedded in the basic education curriculum.

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