

Sustainable Eaters

Consumers in a sustainable Norwegian food system

Research Brief

Advancing Sustainable Food Consumption Sustainability Consciousness and Action Competence among Norwegian Lower Secondary Students

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Food consumption represents one of the most significant sustainability challenges facing Nordic societies. While Nordic countries often perform well on measures of welfare, education, and democratic participation, they also maintain some of the world's highest ecological footprints. Food systems contribute substantially to climate change, resource consumption, biodiversity loss, and social inequalities, making food and food waste particularly relevant topics for Education for Sustainable Development (ESD).

*The challenge is not simply helping young people understand sustainability,
but enabling them to act on that understanding in their everyday lives.*

Key Messages

- **Food-related topics appear to provide a particularly effective entry point for sustainability education** because they connect global sustainability challenges with students' everyday experiences.
- **An interdisciplinary teaching unit on food waste appears to increase students' awareness of sustainable food consumption in the short term.** Preliminary findings indicate higher sustainability consciousness immediately following the intervention.
- **Practical learning activities appear particularly effective in engaging students.** Teachers reported strong student engagement during hands-on activities linked to food waste and leftovers.
- **Changes in attitudes and awareness may not automatically lead to lasting behavioural change.** Teachers observed that some students returned to previous habits shortly after the intervention ended.
- **Developing lasting action competence is likely to require sustained and repeated learning experiences rather than isolated sustainability interventions.** Further analysis is needed to determine how lasting behavioural change can be achieved.

Executive Summary

This research brief examines how an interdisciplinary teaching unit focused on food waste contributes to sustainability consciousness and action competence among Norwegian lower secondary students. The study forms part of the Sustainable Eaters project and addresses the growing need to promote sustainable food consumption through education. Food systems are not only central to environmental sustainability, but also deeply connected to cultural traditions, economic systems, health, and social practices.

The study involved ninth-grade students from three lower secondary schools in Norway and combined an educational intervention, student questionnaires, and teacher interviews conducted both before and after the intervention. The intervention was built around a food waste and "leftovers challenge" teaching unit developed using inquiry-based learning principles and the 5E learning model. Student questionnaires were administered before and after the intervention, generating responses from 178 students at baseline and 143 students following implementation.

Preliminary findings suggest positive short-term effects on students' sustainability consciousness, particularly regarding food consumption and food

waste. Analysis of food-related questionnaire items indicates modest increases in students' awareness of sustainable food consumption and the use of leftovers following participation in the teaching unit. Teacher interviews similarly suggest that students became more conscious of food waste and sustainable food choices immediately after the intervention.

At the same time, teacher reflections suggest that maintaining behavioural change may be more difficult than increasing awareness alone, pointing to a key challenge for sustainability education. Practical activities involving food investigation, meal preparation, and exploration of food waste were reported as highly engaging, while reflective discussions and theoretical components were perceived as more challenging to implement consistently.

Overall, the findings suggest that food waste education can support sustainability learning and contribute to increased sustainability consciousness. However, they also raise important questions about how schools can translate short-term gains in awareness into lasting behavioural change and action competence through Education for Sustainable Development (ESD).

Study at a Glance

- ✓ **Research focus:** Exploring how an interdisciplinary teaching unit on food waste influences students' sustainability consciousness and action competence.
- ✓ **Participants:** Ninth-grade students from three Norwegian lower secondary schools representing rural, suburban, and urban contexts.
- ✓ **Study design:** Pre- and post-intervention mixed-methods study combining student questionnaires and teacher interviews.
- ✓ **Student sample:** 178 students completed the questionnaire before the intervention and 143 students completed it after the intervention.
- ✓ **Intervention:** A 13-hour interdisciplinary teaching unit on food waste and leftovers built around inquiry-based learning and the 5E learning model (Engage, Explore, Explain, Elaborate, Evaluate).
- ✓ **Data sources:** Student questionnaire based on the Sustainability Consciousness Questionnaire (SCQ), supplemented with eight food- and food-waste-related items, and semi-structured teacher interviews conducted before and after implementation.
- ✓ **Instrument reliability:** The food and food-waste scale demonstrated good internal reliability (Cronbach's $\alpha = 0.80$).

Background

The Nordic countries are often considered international leaders in welfare, democratic governance, and education. Yet they also maintain some of the world's highest ecological footprints, creating what researchers describe as the "Nordic sustainability paradox". Food consumption and dietary practices are increasingly recognised as important contributors to this challenge.

Food represents a particularly important area within sustainability education. Food production and consumption influence climate change, biodiversity, resource use, public health, and social equity. Sustainable food consumption is therefore closely linked to several Sustainable Development Goals, particularly SDG 2 (Zero Hunger), but also goals relating to responsible consumption, climate action, and sustainable production systems.

Within the Nordic countries, food consumption presents a notable challenge. Despite strong political commitments to sustainability, Nordic lifestyles remain associated with high levels of consumption and relatively large ecological footprints. Recent reviews have identified

unsustainable dietary patterns as a significant obstacle to meeting climate and biodiversity targets.

Education is identified as a critical mechanism for addressing these challenges. However, sustainability teaching related to food often faces multiple tensions. Questions about what constitutes "sustainable food" remain contested, cultural traditions influence dietary choices, and educational approaches may unintentionally become overly normative or moralising. Researchers therefore argue for interdisciplinary, holistic, and pluralistic approaches to food-related sustainability education.

International research suggests that sustainability education is most effective when it combines interdisciplinary learning, practical engagement, critical reflection, and opportunities for action. Food-related sustainability education provides a promising context for integrating these elements because it is simultaneously global in significance and locally relevant to students' everyday experiences.

Why Food Matters for Sustainability

- ✓ Food systems contribute substantially to greenhouse gas emissions.
- ✓ Food choices influence resource use and biodiversity.
- ✓ Food waste remains a major global sustainability challenge.
- ✓ Food connects environmental, social, economic, cultural, and health dimensions of sustainability.
- ✓ Food choices are part of students' everyday lives.

Conceptual and Theoretical Perspectives

Sustainability Consciousness: A central concept in this study is sustainability consciousness, which refers to individuals' awareness, attitudes, and behaviours relating to sustainable development. The study employs the Sustainability Consciousness Questionnaire (SCQ), a validated instrument developed to assess sustainability-related knowledge, attitudes, and behaviours.

Action Competence: Beyond awareness, sustainability education seeks to develop action competence: the ability and willingness to make informed decisions and engage in sustainable actions. Action competence requires more than knowledge; it also involves motivation, critical reflection, and the capacity to translate awareness into behaviour. From an ESD

perspective, sustainability consciousness can therefore be understood as an important foundation for the development of action competence and more sustainable everyday practices.

Food as an Interdisciplinary Sustainability Issue: Food serves as an ideal interdisciplinary topic because it simultaneously involves environmental sustainability, economic systems, human health, cultural traditions, social norms, and consumption practices.

As such, food and food waste create opportunities for students to examine sustainability challenges from multiple perspectives and across subject boundaries.

Findings

Student Sustainability Consciousness

Preliminary analysis suggests that the intervention contributed to increased awareness regarding food consumption and food waste. Based on responses to eight food-related questionnaire items administered before and after the intervention, students demonstrated modest increases in sustainability consciousness following participation in the teaching unit. Trends in the questionnaire data indicate heightened awareness of sustainable food consumption practices and greater attention to the use of leftovers after the intervention.

The questionnaire component of the study was administered to ninth-grade students at three lower secondary schools in Norway, generating 178 responses before the intervention and 143 responses afterwards.

The food and food-waste scale demonstrated good internal reliability (Cronbach's $\alpha = 0.80$), supporting its use for examining students' attitudes and behaviours related to sustainable food consumption.

While the observed changes appear relatively modest and further statistical analysis is still ongoing, the preliminary findings suggest that food-centred sustainability education can positively influence students' awareness of food waste and sustainable consumption practices. These findings provide an initial indication that food-related topics may serve as an effective context for strengthening sustainability consciousness among lower secondary students.

Practical Learning and Student Engagement

Teacher interviews indicate that practical activities were among the most successful components of the intervention. Students were asked to investigate food products approaching or beyond their best-before date, explore how food can be stored and reused, examine food-related carbon footprints, and develop meals using leftover ingredients. These activities encouraged students to engage directly with food waste and sustainability challenges through inquiry, collaboration, and problem-solving.

The intervention was structured around the 5E learning model, which combines practical investigation, collaborative learning, reflection, and application. Through activities such as sensory testing of food products, carbon-footprint investigations, group discussions, meal preparation, and presentations, students were encouraged to connect sustainability concepts to everyday food choices and practices.

According to teacher reflections, these hands-on activities generated particularly high levels of student engagement and participation. Practical experiences appeared to make abstract sustainability issues more tangible and personally relevant, helping students connect broader environmental and societal challenges to their own lives. At the same time, teachers reported that reflective discussions and more theoretical components of the programme were generally more difficult to implement consistently, suggesting that students may engage more readily when sustainability concepts are connected to authentic and practical learning experiences. Together, these findings suggest that practical and inquiry-based approaches may be particularly effective for making sustainability concepts meaningful and relevant to lower secondary students.

Inquiry-Based Learning as a Sustainability Pedagogy

The intervention was designed around the 5E learning model (Engage, Explore, Explain, Elaborate, Evaluate), an inquiry-based approach that combines practical investigation, collaborative learning, reflection, and application. Through a sequence of structured learning activities, students explored food waste and sustainable consumption by examining food products, investigating carbon footprints, discussing sustainability challenges, preparing meals from leftover ingredients, and communicating their findings to others.

The inquiry-based structure encouraged students to move beyond simply receiving information about sustainability. Instead, students actively engaged with real-world questions, worked collaboratively to investigate possible solutions, and reflected on how everyday food choices relate to broader environmental and societal challenges. This approach aligns closely with contemporary ESD principles that emphasise participation, critical thinking, and action-oriented learning.

Teacher reflections suggest that the practical and exploratory aspects of the intervention were particularly successful in fostering student engagement. Activities that involved direct investigation and problem solving appeared to make sustainability challenges more

concrete and personally relevant than theoretical instruction alone. The findings suggest that inquiry-based approaches may help connect sustainability concepts to students' lived experiences while supporting the development of sustainability consciousness.

Behavioural Change and Action Competence

One of the most significant preliminary findings concerns the relationship between sustainability awareness and behaviour. While questionnaire results and teacher reflections suggest that students developed increased awareness of food waste and sustainable food consumption following the intervention, evidence regarding longer-term behavioural change is less clear. Teachers reported that students appeared more conscious of issues related to leftovers, food waste, and sustainable food choices immediately after the teaching unit, but some also observed that students gradually returned to previous habits over time.

The intervention was explicitly designed to support the development of action competence by encouraging students to investigate, discuss, and take action on sustainability challenges related to food consumption and resource use. Through activities such as evaluating food

products, examining carbon footprints, preparing meals from leftover ingredients, and reflecting on the global implications of everyday food choices, students were given opportunities to connect knowledge with practical decision-making.

These findings highlight a central challenge within Education for Sustainable Development (ESD). While awareness and engagement can be increased through targeted educational interventions, translating that awareness into sustained behavioural change may require repeated opportunities for practice, reflection, and reinforcement. The preliminary findings therefore suggest that developing action competence is likely to be a gradual process that extends beyond a single teaching unit and may depend on continued support from both schools and students' wider social environments.

Food Waste as a Vehicle for ESD

Food waste emerged as a particularly relevant and accessible context for Education for Sustainable Development (ESD). Unlike many sustainability issues that can feel distant or abstract, food waste is closely connected to students' everyday lives through the choices they make at home, at school, and as consumers. This provides opportunities for students to engage with sustainability challenges in ways that are tangible, meaningful, and personally relevant.

Through the intervention, students explored food systems, food storage, leftovers, carbon footprints, resource use, and sustainable consumption practices. These activities enabled students to examine environmental issues such as climate change and resource use, while also engaging with social, economic, cultural, and health-related dimensions of sustainability.

Food waste therefore functioned as an interdisciplinary topic that connected multiple perspectives on sustainable development within a single learning context.

The findings suggest that food waste may be particularly valuable as a vehicle for ESD because it provides a visible link between individual choices and broader sustainability challenges. By investigating the consequences of food waste and exploring ways to reduce it, students were encouraged to reflect on how everyday actions relate to wider issues such as responsible consumption, food security, climate change, and sustainable resource management. In this way, food waste served not only as a topic for learning about sustainability, but also as a practical context for exploring how sustainability can be enacted in everyday life.

Challenges for Implementation and Practice

From Awareness to Behaviour Change

The intervention appears to have increased students' awareness of food waste and sustainable food consumption. However, teacher reflections suggest that some students returned to previous habits shortly after the intervention. This highlights a common challenge in

ESD: increased awareness does not necessarily translate into lasting behavioural change. Developing action competence may therefore require sustained engagement over time rather than single interventions.

Balancing Practical and Reflective Learning

Practical activities were reported as highly engaging and meaningful for students. At the same time, teachers found reflective discussions and theoretical components more challenging to implement. Effective sustainability

education requires both practical experiences and opportunities for critical reflection, helping students connect everyday choices to broader sustainability challenges.

Connecting Everyday Choices to Complex Sustainability Challenges

Food is an accessible entry point for sustainability education because it is closely connected to students' daily lives. However, helping students understand how personal food choices relate to wider issues such as climate change, resource use, food security, and social

justice can be challenging. Exploring these links often requires interdisciplinary teaching across multiple subjects and perspectives. Sustaining such interdisciplinary approaches beyond individual projects therefore remains an important challenge for schools.

Implications

The preliminary findings from this research provide several important implications for the design and implementation of sustainability education in schools. While the intervention appears to have increased

students' awareness of food waste and sustainable food consumption, the findings also highlight the challenges involved in translating awareness into lasting behavioural change.

Leveraging Food as a Context for Sustainability Learning

Food and food waste provide particularly valuable entry points for sustainability education because they connect global sustainability challenges to students' everyday lives. Through food-related topics, students can explore issues such as climate change, resource use, food security,

health, culture, and responsible consumption in ways that feel relevant and tangible. The findings suggest that food waste can help make sustainability more visible and meaningful by linking abstract concepts to everyday experiences and choices.

Developing Action Competence Through Repeated Practice

The intervention suggests that practical and inquiry-based activities can support sustainability consciousness and increase student engagement. However, teacher reflections indicate that increased awareness may not automatically lead to lasting behavioural change. Developing action competence therefore appears to

require more than a single educational intervention. Schools may need to provide repeated opportunities for students to investigate sustainability challenges, reflect on their choices, and apply sustainability-related knowledge in different contexts over time.

The Potential of Inquiry-Based Sustainability Education

The positive response to the practical and investigative elements of the intervention highlights the potential of inquiry-based learning approaches within ESD. By encouraging students to explore authentic problems, work collaboratively, and test possible solutions, inquiry-based pedagogies may help bridge the gap between

knowledge and action. These approaches may be particularly valuable when addressing sustainability issues that require critical thinking, systems understanding, and engagement with real-world challenges.

Embedding Sustainability Across the School Environment

The findings point to the importance of moving beyond isolated interventions. Lasting changes in sustainability-related attitudes and behaviours may depend on a broader school culture that reinforces sustainable practices through teaching, school routines, food-related

activities, and opportunities for student participation. Food-related education may therefore provide a useful starting point for developing whole-school approaches to sustainability that connect classroom learning with everyday practice.

Implications for Future Research

The preliminary nature of these findings points to several areas requiring further investigation. In particular, future research should examine:

- ✓ Whether observed increases in sustainability consciousness are statistically significant.
- ✓ Which aspects of sustainability consciousness are most strongly influenced by food-related interventions.
- ✓ How long behavioural changes persist following intervention activities.
- ✓ Which pedagogical approaches are most effective for supporting long-term action competence.

- ✓ How practical activities and reflective learning can be combined most effectively within sustainability education.
- ✓ Whether similar interventions produce comparable outcomes across different school contexts.

Understanding these factors will be important for determining how food-related sustainability education can contribute to broader educational goals associated with sustainable development and sustainable consumption.

Conclusion

Food and food waste represent powerful contexts for Education for Sustainable Development because they connect global sustainability challenges with students' everyday lives. Preliminary evidence from the Sustainable Eaters project suggests that interdisciplinary teaching on food waste can increase sustainability consciousness and promote reflection on sustainable consumption practices.

At the same time, the findings highlight a persistent challenge within ESD: increased awareness does not

necessarily translate into lasting behavioural change. Future analysis will help clarify how sustainability consciousness develops over time and what educational approaches best support long-term action competence among young people. More broadly, the findings suggest that food-related sustainability education can play an important role in helping young people connect global sustainability challenges with everyday choices while also highlighting the need for educational approaches that support lasting behavioural change.

References

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Information note on research

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This research was conducted in relation to the Research Council of Norway-funded project **Sustainable Eaters**, led by Nofima in collaboration with 26 partners from research, industry, the public sector and non-profit organisations.

Teaching Resources

The intervention referred to in the study – a teaching module on food waste and leftovers – is available in a revised version as a resource booklet: 'The Leftovers Challenge – An interdisciplinary resource booklet for lower secondary schools'. It is available in both printed and digital formats.

- **MATSYSTEMER OG MATSVINN** – *Fag som inngår er naturfag, samfunnsfag, KRLE og norsk.*
- **RESTEMAT CHALLENGE** – *Fag som inngår er mat og helse samt naturfag.*

The booklets have been developed by Matvett, the Centre for Collaborative Learning for Sustainable Development at the University of Inland Norway, and LOOP Miljøskole.

Available at: <https://www.inn.no/ccl/ressurser-for-l%C3%A6rere/matsystemer-og-matsvinn/index.html>



Additional activities and resources available at: <https://www.matvett.no/>