Sustainable Diets

A submodule in the SustainComp Curriculum

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ABSTRACT*: The SustainComp project was initiated in response to the pressing challenges faced by the EU in terms of health, environment, and climate change. With a focus on cross-border collaboration, the project aimed to develop a future-oriented curriculum on sustainable development for Higher Education Institutions. One of the submodules, Sustainable Diets, focuses on diets with low environmental impacts which also promote food security and adequate nutrition, leading to healthy lives for current and future generations. Promoting these diets are essential for achieving the UNs sustainable development goals. This paper describes the development of this submodule and the assessment of the full-scale pilot carried out in October 2023 with teacher education students in Denmark. The research question is: How did students perceive the content, the competence acquired, and delivery of the submodule Sustainable Diets?*

The data was collected from a student survey conducted immediately after the end of the submodule.

The results showed that the student's pre-competences in this topic varied. After the full-scale pilot most students expressed that their competencies in the topic sustainable diets increased to some or to a large degree (60 % to 84 %). Even though most of the students expressed benefits with online teaching, some preferred the teachers to be physically present. The findings also emphasized that short teaching videos and instruction videos for the student-active activities, were valued by the students.

KEYWORDS: *Sustainable Diets; Teacher education students; blended learning; student active learning; Higher Education Institutions*

Introduction

In both the European Union and the global landscape, we are confronted with significant obstacles pertaining to health, environment, and climate change (Romanello et al., 2023). They constitute major challenges for the prosperity of citizens and countries. The solutions to these obstacles are complex and emphasize the demand for cross-border-, North-South EU-, educational and intercultural collaboration. The educational sector at Higher Education Institutions (HEIs) also play an important part in these challenges as students are citizens of both today and the future. The Sustainable Competences in Higher Education (SustainComp) project received a grant on the Erasmus+ 2021 call: KA220-HED - Cooperation partnerships in higher education(EU, 2021)). The SustainComp project wanted to place the partnership between four experienced HEIs, in Czech Republic, Slovenia, Norway and Denmark, at the center of a much-needed development of a future-oriented curriculum. There was a lack of a curriculum within sustainable development at the participating HEIs. Instead of each HEI developing its own curriculum, the partners wanted to enter into a joint partnership to develop a common curriculum for HEIs in the EU. This is the core idea of SustainComp.

Further, SustainComp aims to bridge the gap between sector-divided, discipline-embedded national curricula in education and address the current need for competence-based, integrated, interdisciplinary, and transformative Higher Education that is in congruence with the European Council Erasmus+ program and the 21st Century skills (Joynes, Rossignoli, & Amonoo-Kuofi, 2019). Through the SustainComp project the aim was to positively impact and update the current curricula by developing a new 10 ECTS curriculum, learning objectives, digitalization readiness, transversal skills and effective intercultural communication for students from different areas of bachelor education.

A SustainComp curriculum of 10 ECTS (European Credit Transfer and Accumulation System) was collaboratively developed and included four parts (submodules). 10 ECTS translates to approximately 250-300 student hours as suggested time spent on this course. We will first give a short description of how the four submodules were conducted. Further, the University of Agder (UiA), Norway, developed the Sustainable Diets submodule of 2.5 ECTS. Critical thinking, informed decision making and knowledge about sustainable diets were important topics to consider regarding the students learning outcomes. This paper describes the development of this submodule and the assessment of the full-scale pilot carried out in October 2023 with students from University College Lillebaelt (UCL) in Denmark. The research question is: How did students perceive the content, the competence acquired, and delivery of the submodule Sustainable Diets?

SustainComp Curriculum, 10 ECTS

The SustainComp curriculum aims to develop sustainable, global, and intercultural competencies of students in bachelor's degree study programs in HEIs across Europe. Competencies is defined as the "specific attributes individuals need for action and self-organization in various complex contexts and situations"(UNESCO, 2017). The students will engage in collaborative tasks and activities relating to four topics connected to sustainability; 1) Sustainable Diets, 2) Sustainable Health, 3) Consumer Behavior, and 4) Natural Resources, Social Inequality and Sustainability. Each sub-module has a teacher guideline to assist the instructors and lecturers in the curriculum delivery. An online teacher training course-guide is also developed to aid in

the delivery. The curriculum relies on innovative, project-oriented teaching methods, including Collaborative Online International Learning (COIL), as tools towards improvement of students' digital, intercultural, and international team-work competencies. Student inter-active learning and assessment methods will be used including formative evaluation. While the curriculum aims primarily at bachelor students at HEIs, it is open to international students across the world.

The SustainComp curriculum is based on the UNESCO framework for Education for Sustainable Development (ESD) and draws on the cognitive, socio-emotional, and behavioral domains of learning (UNESCO, 2017). The multimodal educational resources in the curriculum include the UN Sustainable Development Goals (SDGs) with the aim to develop students' competencies pertaining to sustainability (United Nations, 2015). The curriculum further supports students in building sustainable competencies and transversal skills for 21st century (Joynes et al., 2019). These are critical thinking, creative problem-solving, empathy and communication skills that enhance students' capability to apply ethical judgments to personal and professional actions informed by global perspective (UNESCO, 2017).

Through the modules, the students will raise their awareness, partake in discussions, improve their creativity and enable them to make suggestions on how to promote values congruent with sustainability, consumption habits and lifestyles. Structural changes in society that drives population behavior change will be emphasized in the curriculum. They will also develop intercultural competencies for appropriate intercultural communication and will be encouraged to share different perspectives in work with peers.

A pre-requisite in this 10 ECTS module is English B2, and it is not part of obligatory bachelor education.

Sustainable Diets

For the world to achieve the UN SDGs, address climate change, natural disasters, and the global increase in non-communicable diseases, sustainable diets must be adopted by all populations. The Food and Agriculture Organization (FAO) defines sustainable diets as:

> Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources. (Burlingame & Dernini, 2012)

The definition thus incorporates many elements including environmental, societal and economic factors.

Today, food production accounts for ¼ of global greenhouse gas emission (Poore & Nemecek, 2018). However, the environmental impact of different foods differs greatly (M. Clark et al., 2020; Michael Clark et al., 2022). Most of the greenhouse gas emissions within agriculture come from the production of animal products, predominantly meat from ruminants (M. Clark et al., 2020), whilst many of the foods that are associated with disease risk reduction, like fruit and vegetables, whole grain, nuts, and pulses have low environmental impact (M. A. Clark, Springmann, Hill, & Tilman, 2019). Shifting to a more plant-based diet will therefore have a positive impact on both public health and planetary health (Bellamy et al., 2023; Blomhoff et al., 2023; M. Clark et al., 2020; EAT-Lancet Commission, 2019; World Health Organization, 2019). Many national dietary guidelines recommend increasing the number of plant-based

foods in our diet, and reducing or limiting meat consumption, from a health and environmental perspective (Blomhoff et al., 2023; Fischer & Garnett, 2016). In addition to food production itself contributing considerably to greenhouse gas emissions globally, around 10% of global emissions are associated with food that is produced, but never consumed (United Nations Environment Programme, 2021). Hence, to achieve UN SDGs, a change towards a more sustainable diet and reducing food waste is needed.
Food literacy refers to the concept of being skilled and knowledgeable in matters related to food (Truman, Lane, & Elliott, 2017). However, food literacy varies among young people. Individuals with higher food literacy are more likely to make healthy and sustainable food choices (Groufh-Jacobsen et al., 2023; Lee, Kim, & Jung, 2022).

The Sustainable Diets submodule

Through the Sustainable Diets submodule, we wanted to enhance the student`s ability to make personal informed choices and understand the complex area of diet and sustainability. To achieve this, one of the key sustainability competencies to develop is critical thinking. This competency encompasses the ability to reflect on one's own values, perceptions, and choices, as well as the capacity to question general opinions(UNESCO, 2017). Both Dewey (2024) and Illeris (1985) suggested that education should focus on issues within a student's own environment, giving them the opportunity to actively solve problems and by that develop critical thinking competencies along with creative problem solving competencies. Real-life experiences are also by Annelin and Boström (2023) suggested as the best way to learn interconnected sustainable systems. The sustainable diets topic necessitates an interdisciplinary and balanced approach, considering both individual and societal responsibilities. According to UNESCO (2017), systems thinking is a crucial competency for students to develop in order to achieve comprehensive SDG competence. This includes the ability to analyze complex systems and to recognize and understand its relationships. Tolppanen and Kärkkäinen (2021) found that few pre-service students examine climate change mitigation through a system thinking approach. A broad approach is important to address both individual and structural issues in ECD. The UNESCO (2017) report state that we need a shift from teaching to learning. This includes problem-solving and students active learning that are action-oriented, along with participation and collaboration. In addition, the multi- disciplinary approach is also highlighted in the UNESCO report. These principles and the principles for 21st century skills informed the development of this submodule.
With this in mind, we outlined our module of Sustainable Diets (2,5 ECTs). The overall aim of the submodule is to give the students an introduction to sustainable diets and how these diets contribute to reaching the UN SDGs globally and locally. Three student activities are developed (see figure 1). The intended knowledge competencies the students should require was basic characteristics of sustainable diets, the environmental footprint of different food groups, food waste and be able to describe and evaluate the sustainability of national dietary guidelines. Regarding skills the students should acquire through the submodule, the ability to discuss and share knowledge about sustainable diets, compare dietary guidelines, and act for changing the local environment were outlined. A general competence in the ability to reflect and discuss ethical issues of the topic was included. Through the three activities that we developed, these competencies should be possible to acquire (see detail below). We wanted to promote all

three domains described by UNESCO starting first with a specific focus on adopting cognitive skills and socio-emotional skills in activity 1 to make a theoretical foundation and start the critical thinking process. Further to focus on the behavioral domain which comprises action competences in the last two activities.
Since this was a basic course for bachelor students, we assumed that the student had little insight into the concept of sustainable diets before attending the course. While these three activities can be taught in a separate and random order, we recommend following our suggested sequence to ensure the most optimal and effective learning progression.

Figure 1: The content of the Sustainability diets submodule

Activity 1: Environmental impact of food groups

The objective of this activity was that the students should develop basic knowledge on the environmental impact of different food groups, in addition to acquire knowledge on how to assess the environmental impact of food and identify in which part of the food chain the emissions are the greatest.
In this activity, students collectively assess the ecological footprint of various food categories in a group of three to five students. First, the students rank a set of food pictures from which they believe is the most to least sustainable, discussing and agreeing on a common order. In plenary, each picture is discussed, when the groups present their arguments underlying their choice of order. Then, the students assess the actual environmental footprint of the food through the Our World In Data tool which is based on the work of Poore and Nemecek (2018): Explore data on the Environmental Impacts of Food (Ritchie, Rosado, & Roser, 2024). The focus lies on understanding and visualizing how different food groups influence environmental factors such as usage of fresh water and land, and greenhouse gas emissions. Based on the result, the students review their initial ranking of the food pictures and discuss whether any changes are necessary. Finally, the students assess the level of sustainability of the dietary guidelines in their respective countries. Short teaching sequences about sustainable diets are carried out along with the student active tasks.

Activity 2: Food Waste

The objective of this activity was to acquire basic knowledge on the environmental impact of food waste and how to take action to reduce food waste.

In this activity, students explore food waste in different parts of the food chain (e.g., farming or transport), its economic and environmental consequences, and potential actions to reduce food waste at a personal and system level. The student or teacher collects leftovers from one bakery for one day. The students calculate the value of the collected leftovers based on their package pricing using a scheme made for this project called *Measuring the leftovers*. Also, climate impact is calculated by using the Our World In Data tool. The students discuss how food waste can be both reduced and exploited. If kitchen facilities are available, the students can make food from the leftovers and share the meal. In groups, the students discuss the economic and environmental impact of the leftovers. In addition, to find the amount of food waste in their country and analyze the distribution of food waste across the food sector. Finally, students reflect on how they can take personal actions to reduce food waste and share their reflections in groups. The students' active tasks are incorporated with short teaching sequences on food waste.

Activity 3: Sustainable food environments

The objective of this activity was to evaluate the environmental footprint of local food suppliers' food offerings (e.g., student cantina or a local supermarket). In addition, the students should be able to argue for possible solutions to make the food offered more sustainable.
In this activity, students learn about sustainable food environment and then explore and assess the food environment at a local food supplier. To facilitate creative and participating dialogue, the students work in World café (Brown, 2010), which also prepares them for field work. In groups, the students visit a local place where food is offered, such as a campus canteen, and observe what is offered and how it is presented. The groups will document which food they observe and how it is presented by taking photographs. The observations and photographs form the basis of the group discussions to evaluate the food environment and suggest feasible ways to make it more sustainable. Finally, the findings are presented in plenary.

Development of the Sustainable Diets curriculum

The SustainComp curriculum, which the submodule Sustainable Diets is a part of, was developed through a cyclic process, resulting in a comprehensive and multidisciplinary approach to sustainability education (see table 1).

Table 1: Structure and timeline of the development of the SustainComp curriculum

Time	What	Description
Spring 2022	Early development of parts of the content of the submodules	Outlining goals for the students to achieve and preparing activities for the students to meet these goals.
Autumn 2022	Trying out parts of the module	Carried out with other members of the project and students from Brno, The Czech Republic. Receiving responses from and getting inspiration from other submodules in SustainComp.
Spring 2023	Feedback on the written materials	The institutions included in SustainComp worked in pairs, giving input on the written materials.

Spring 2023 (April)	Pre-pilot	Teacher education student from Norway and Denmark attended. First, a digital event (COIL) of 1,5 hours and secondly 4 hours at Campus in UCL, Denmark. The students tried out activity 1 from Sustainable Diets submodule
Autumn 2023 (September)	Full-Scale-Pilot	Carried out in Denmark. See description in Full scale pilot (below)
Late autumn 2023	Preparing the materials	Revising the submodule based on the results and experiences from the Full-Scale-pilot.

The pre-pilot conducted in April 2023 yielded valuable feedback due to its implementation with students from two countries. The COIL event that was conducted prior to the physical meeting during the pre-pilot had the potential to serve as a valuable introduction and ice-breaking event for the students. It also allowed the students to initiate discussions and engage in critical thinking about the topic. However, the Danish students who participated online were not the same as those who attended the physical meeting, and COIL proved therefore to be less effective. It would have been preferable if the same students participated in both the online and physical settings. However, the Norwegian teacher education students who participated in both events, acted like resource persons when they meet the "new" Danish students. At the physical meeting, we observed a high level of interaction and engaging discussions between the student groups relating to the task of ranking the sustainability of different food groups (Activity 1). Then, the students found the correct answer in "Our World In Data". Afterwards there were hardly any discussions. Due to this experience, we modified the follow-up questions for the full-scale pilot to encompass broader aspects and introduce new elements that would foster greater critical thinking. Some notable examples include reflecting on the production of sheep meat in comparison to beef production and addressing ethical concerns in teaching this subject in schools that may arise if a student's family is involved in beef farming, among others.

Full-scale pilot

The most crucial feedback received for this submodule came from the full-scale pilot conducted at UCL in Odense, Denmark in October 2023. The term full-scale pilot was used because it included piloting all the four submodules within the SustainComp curriculum, including all the student activities. Hence, in the SustainComp project a full-scale pilot was defined as the hybrid event where all the four submodules were carried out with students. The students who participated belonged to two distinct groups at UCL, Denmark. The first group comprised 40 Danish first-year teacher education students who were enrolled in an English course (English 1). The second group consisted of eight international students attending a course in Education for Sustainable Development (ECD2). Due to the students' busy schedule, which included practice in public schools, we adjusted to two weeks in which our submodule was carried out and modified it to be more digital (see table 3). Four hours of joined sessions were scheduled on each of the three days when the submodule was conducted, providing ample

time for in-depth learning and critical thinking. The students were also required to dedicate time between lessons to prepare posters as part of their coursework.

A blended learning approach was used in this submodule which combines face-to-face teaching with online teaching (Graham, 2006). This involved creating six short videos related to the theory for the activities (from 2.17 min to 11 minutes), as well as three instructional videos to guide participants through tasks, such as using "Our World in Data". The videos were of good quality with respect to both the sound and visuals. One of the lectures from UiA attended digitally in some sessions in real-time.

The Danish lectures who provided the physical teaching were skilled in sustainability topics, although their expertise did not pertain solely to food-related topics. These lecturers knew the students and the institutional requirements. A detailed plan was drawn up in TEAMS which also served as a template for the other three submodules that were conducted later in fall of 2023. Throughout the process, the lectures form UiA provided continuous support and guidance to the lectures at UCL that lead the teaching at campus.

Table 2 Schedule of Sustain Diets submodule in Full-Scale Pilot, two weeks in October 2023

Time	What	Description
Tuesday 4 hours	**Introduction** **Activity 1: Environmental impact of food groups** • Instruction to the task and processing • Lectures on sustainable diets and how to take sustainable dietary choices • Processing and presentation	• Short video introducing the submodule Sustainable Diets. • Video and group work of ranking the sustainability of food groups. • Videos • Group work and plenary discussion
Between lessons	• Study time making posters	• Group work
Tuesday 4 hours	**Activity 2: Food waste** • Instruction to the task and processing • Lecture on food waste • Wrap up	• Introduction by teacher and group work measuring the price and carbon footprint of food collected (from "TO good to go") • Video • Plenary
Friday 4 hours	• Follow up from Tuesday. Results from the measurement and how the leftovers were used. **Activity 3: Sustainable food environment** • Introduction • Lecture on sustainable food environment • Visit to the canteen • Finishing the posters **Wrapping up**	• Digitally with the lecturer from UiA and the students presented what they made or ate of the leftovers measured in Activity 2 • Real time digitally by lectures from UiA • Video • Observation in the canteen and information from the staff on their sustainable priorities. Discussions afterwards in class • Group work
December 2023	• Poster presentation on the multiplier event	• All nine posters from the Sustainable Diets submodule were presented. The

		students answered questions from the participants attending the event

In activity 2 and 3 we had to do some adaptations due to the context. The purpose in activity 2 was to collect leftovers from a local bakery. This was not possible in this area, and baskets from "Too good to go" were bought instead (To good to go, 2024). The template the students had to fill out to measure the footprint of the collected food (using "Our world in data"), was hard to understand for some of the groups. Despite having tied out online in advance, online teaching and coaching proved to be challenging due to some unforeseen technical difficulties. In activity 3 the students saw a video about sustainable food environments. After that the purpose was to visit the canteen or a nearby shop, take pictures and critically consider the level of sustainable food environment based on the knowledge they acquired through the prior digital lecture. A visit to these locations was not feasible. Instead, the canteen employee offered to give an introductory speech of their sustainable prioritizations and suggested no pictures be taken. Due to limited time, the planned "World café" was not carried out.

Nine posters were made by students for this submodule. Seven of them were rich in text and one of them was made into two pages to fit in all the information. Four of the groups made posters in a specific poster program (Canva) and the rest used Word or PowerPoint. All posters from the four submodules were presented at the end of the full-scale pilot (December 2023). Two of the nine Sustainable Diets posters had no references, and the rest had from one to six references. The presented topics demonstrated a wide range of diversity, with several encompassing multiple subject areas. Four presentations delved into food production and delivery, exploring strategies to diminish ecological footprints in both bakeries and supermarkets. Additionally, four presentations centered on the pressing issue of waste management. One presentation focused on fostering sustainability practices within households, while another explored how schools could offer sustainable and cost-effective food options. Lastly, there was a presentation solely dedicated to the merits of a vegetarian diet. The topics that the students chose to delve into in these posters included several topics with an emphasis on the food chain before the food reaches the consumer. These topics gained potentially their interest because it was new for them and not common knowledge, they had adopted elsewhere.

An introduction of criteria for good posters could have been included at the beginning of this first submodule. However, the posters that the groups made later in the semester were mostly made with poster-programs with an improved design, more specified themes and less text. The students learned from each other and developed their critical thinking skills during the design process. Simultaneously, they gained valuable insight into how to distill essential information from a given topic. These skills align perfectly with the 21st-century skill of creative problem-solving (Joynes et al., 2019). Nonetheless, the time allocated to crafting their designs may have detracted from their focus on ESD-related content.

Method for assessment

A survey with both fixed and open-ended questions were administered to students who completed the submodule Sustainable Diets in the full-scale pilot. These types of surveys are commonly used in measuring students sustainable competencies (Redman, Wiek, & Barth, 2021).

The survey was developed for this study by colleagues from UCL, Denmark. It was piloted among the members in the SustainComp team. Afterwards, some adjustments were made based on the feedback.
The questionnaire consisted of two background questions (country of birth and type of study), following three questions about sustainable diets (if the students had acquired *new knowledge about Sustainable Diets, new competences on food waste and new knowledge about sustainable food environment*). Further, 13 general questions followed about sustainability and how the students think about teaching about sustainability (if the students had acquired e.g., *new ideas for teaching sustainability in schools, new knowledge about UN Sustainable Goals and intercultural competences*). All these items had three response alternatives: *low degree, to some degree* and *high degree*. At the end, the survey included two open ended questions about blended learning (22 students responded) and suggestions for improvement of the submodule (17 students responded).

Analysis and results

Student survey

The survey was completed by 24 students, in addition one more student answered the first 11 questions. Of the two groups attending the full-scale pilot, one student from the eight ESD teacher education student answered, and 24 of the 40 teacher education students in English answered. In total, 17 of the 24 students were Danish. On the question about new knowledge about sustainable diets, 60 % answered *to some degree* or *high degree*. Similarly, 72 % answered the same on the question about new competencies on food waste, and 84 % for new knowledge on sustainable food environment, respectively. Most students (72 %) also reported that they had learned to some or high degree about the UN SDGs and 62 % reported the same for more knowledge about UNESCO and teaching sustainability.
The first open-ended question was about what the student thought about the educational method used: blended learning. Half of the students who responded to this question expressed their support of blended learning and one wrote "*Great Way of connection*", another *"different approaches make lesson more dynamic*" and another *"It was a good idea. I feel like it provided new intercultural insight, because I could see how the topic food diet is assessed in Norway".* However, seven students expressed a preference for having the teacher physically present. One student stated this: "*Personally I like physical presence, but since we work with other countries we will have to do. It works, but I feel I learn better when I have a teacher who is here physically".* Additionally, some said that the videos were very good, but a few were negative to the videos.

Regarding the last open-ended question about suggestions for improving the submodule, several students did not provide any comments or replied that they had no suggestions for improvement. A few argued for improvement of the technical elements and better layout. The most prevalent issue raised by students was their inability to see the relevance of the topic being taught. Here is a statement: *"I think this course seems irrelevant to our education. I understand the importance of sustainability and food waste but I'm lacking relevance to what we work with as a teacher education student*". The degree of difficulty in adopting the topic was not consistent. One student suggested that it was too early to cover this topic in the first year in teacher education, while two others felt that the material was too basic.

Discussion

Overall, the students perceived the Sustainable Diets submodule as well delivered, they increased their competences and they appreciated the content. Most of the students responded in the survey that they had increased their competences in the field of sustainable diets to some or high degree. The survey showed highest score on the item about new knowledge on food environment. This may indicate that this topic was perceived as the most interesting. This may be due to this subject being novel for the majority of students and that it was the most recent topic discussed in the submodule before they answered the survey, thus more salient in their mind. We also noticed that this topic was salient in many of the student posters. Education on the food environment takes into consideration the interconnectedness between food choices and a range of societal issues. It is likely that the students have enhanced their system thinking competencies (UNESCO, 2017) due to recognizing relationships and gaining new insights into complexity. The students' perception of the Sustainable Diets submodule's degree of educational difficulty varied. Considering that everyone possesses some degree of knowledge and experience in the field of food and diets, coupled with the abundance of information and discussions on diverse diets in the social media, it becomes challenging to determine the appropriate competence level. However, providing ample room for student activity allows them to work at their individual levels, fostering an environment where students with different competencies can enhance and expand their knowledge. A study conducted in Germany investigated the effectiveness of a university curriculum featuring plenary sessions and kitchen lessons in promoting a planetary health diet among students (Rosenau, Neumann, Hamblett, & Ellrott, 2024) The results were similar to ours: the students reported higher planetary health literacy after completing the curriculum. Courses targeting college students with a focus on the connection between food and environment, also showed reductions in the students environmental food print, especially for female students(Jay et al., 2019; Whitener, Cook, Spielbauer, Nguyen, & Jay, 2021).

Most of the students were positive that we used different approaches to teaching, but we see a potential for improvement that could have engaged even more of the students. We started out with an activity which was more theoretical than the two last activities. Student engagement may be easier to accomplish if the teaching starts with a practical challenge e.g., making sustainable food in a kitchen or prepare leftovers for eating. This might be more in line with Illeris (1985) problem-based learning. However, there might be a lack of teaching kitchen available in different HEIs. The initial activity of ranking food groups is straightforward to execute for the lecturer and equips participants with the necessary skills to better undertake the subsequent two activities. A notable challenge arising from the predominant focus on student participation in Illeris pedagogy, is the potential arbitrariness in substance access (Saugstad, Gabrielsen, & Saugstad, 2021). In response, we sought to strike a balance by incorporating both problem-based student work and lectures on the subject matter, aiming to ensure that students acquired the necessary theoretical foundation.

Most students reported that they had learned more about food waste and food environment. Our aim for the student's work were to develop critical and system thinking through active learning in a real-world approach in line with the work of Illeris' (1985) and Annelin and Boström (2023). Therefore, in activity 2, leftovers from a bakery should be collected, and in activity 3, we encouraged the students to observe and take pictures of local food suppliers'

food offerings (e. g., canteen). These activities are usually possible to implement in a Norwegian setting. However, we had to adjust. Even though Denmark and Norway have quite similar culture, we saw that for specific issues, there are practical differences. Therefore, we have added alternatives in the descriptions for the submodule to hopefully make the activity more usable in various cultures and therefore easier for others to carry out these practical activities in future. To ensure the best learning outcomes it is important to thoroughly ensure the feasibility of especially practical tasks before conducting these types of activities in different countries and cultures. Another viable option is to selectively implement relevant components of the submodule that align with the teaching in the respective Higher Education Institutions (HEIs). Despite the challenges encountered, the students appeared to achieve higher competencies on various topics. These outcomes seem to suggest that our practical approach to the learning tasks was effective.For effective implementation of problem-based learning, it is crucial to allocate dedicated time. Even though we had to adjust the submodule to the student's schedule to some extent in the full-scale pilot, the lessons available lasted for as long as four hours, which probably contributed to deeper understanding and interesting discussions compared with more segmented lessons. Through making posters in groups between the lessons in class, the students was encouraged to develop creative problem-solving and discussion skills (UNESCO, 2017).

One of the student groups participated in an English course, and it is understandable that they questioned the integration of this submodule into their curriculum. If greater emphasis had been placed on teaching methods for this particular topic in schools, it may have provided the teacher education students with the anticipated competencies. Additionally, receiving more feedback in the survey from the students studying ESD could have balanced out the responses. Blended learning which combines digital and physical education like we did in the full-scale pilot, encompassing the possibilities of collaboration and widened the flexibility of learning and may also give the participants more time to reflect (Graham, 2006). Further, at the same time Graham (2006) highlights the strengths of face-to-face meetings with human connection and by that develop trust and be spontaneous. In the survey after the full-scale pilot the students response of the benefit of collaborating with a wide range of people digitally, is in line with the benefits Graham (2006) talks about for the digital part of blended learning. At the same time, physical presence is preferred by many of the students. If we as online teachers had been familiar with the students in advance, it may have been easier to discuss and coach the students also online.

One of the students commented that she/he was provided with new intercultural insight. Among the students many were from different countries (seven out of 24 who responded to the survey) and this might have given them some cultural insight through discussions in lectures and groups, but this was not particularly mentioned in the survey-answers. In the full-scale pilot, the activities were not carried out with students from other countries digitally (only lectures from Norway). Activity 3, about local food suppliers' food offerings, may have suffered from this lack of incorporating student groups from other countries. Given the opportunity to get insight into how other student canteens in other countries dealt with sustainability, may have added value to the understanding of the country differences and culture-specific challenges. Jie and Pearlman (2018) say that through this type of online collaboration the students can learn the content through their own and other's unique cultural lenses and build knowledge together. Such oral collaboration might have made the topic of Sustainable Diets more suitable and engaging for the largest group of students who were critical to this topic being incorporated in their English curriculum. As part of the SustainComp project, our trans-

national project meetings enabled us to explore various campus canteens and provided us with valuable insights into the complexities involved in serving healthy, delicious, affordable, and sustainable food while also accounting for cultural differences. For those students who opted to undertake activity 3 with international students, there is a potential to gain a similar level of experience and understanding, also digitally. A potential positive issue of activity 3 was that the activity was carried out in students' own environment, which aligns with Illeris' (1985) educational philosophy.

During the full-scale pilot, we used teaching videos that ranged from two to eleven minutes in length. According to Manasrah, Masoud, and Jaradat (2021) the optimal video length ranges from 6 to 10 minutes. Their research indicates that videos that are too short lack depth, while videos that are too long risk becoming tedious and unengaging. Even though we got some negative feedback on how well the videos worked, the overall impression and feedback was that it worked well. The videos' effectiveness can be attributed to their ability to act as a summary or a prelude to the students' active learning in class. Research has shown that if videos are used in combination with other modalities, e.g., in groups as we did, it is more likely that the videos become an effective learning tool (Seidel, Blomberg, & Renkl, 2013).

In order to reduce the time students spent learning how to use the "Our World in Data" platform and other tools, we developed instructional videos which was valued by the students. The importance of this approach lies in its potential effectiveness (Cooper, Higgins, & Beckmann, 2017). By providing clear instructional guidance, students were able to quickly and efficiently navigate these digital tools. In cases where certain tasks need to be carried out by lecturers who may not be entirely familiar with the topic, it is imperative that such lecturers receive a comprehensive training. Alternatively, the instruction provided should be very user-friendly and intuitive. This was highlighted during the full-scale pilot when the students filled out the scheme *Measuring the waste* (activity 3), which was subsequently restructured to become more intuitive, as the initial design did not effectively fulfill this requirement. Coaching online for this task presented a significant challenge. An introductory video would have been highly beneficial for this task, as it would have allowed students to watch the instructions multiple times. This repetition could greatly enhance their understanding and comprehension of the task, which is specifically important for students without English as their first language. Language difficulties could arise due to the use of specific terminologies in this new subject area, particularly for learners who are unfamiliar with the English language. Consequently, it's crucial to invest time in clarifying crucial concepts.

Due to technical improvements over the last years, online teaching has improved considerably and the pandemic has raised the general digital competencies both among students and lecturers (Ng, Leung, Su, Ng, & Chu, 2023). Still, we encountered some challenges in our teaching. A dedicated person to take care of technical issues is an advantage, however not always possible.

Limitations of the study

A limitation of this study was that the full-scale pilot of the submodule Sustainable Diets was carried out solely in one country with a limited number of students from two different student groups. The students may perceive the curriculum differently due to different cultural, ethical and educational backgrounds. If the time and resources were available, scaling up would have been beneficial. For the Sustainable Diets submodule, COIL activities could have engaged the

students in challenges and benefits of sustainable diets issues in various cultures, but this was not carried out due to limited resources.
The student survey was administered shortly after the completion of the submodule, thereby ensuring that students had a recent recollection of their experiences and how they perceived the submodule. The results were self reported, which is a common way of assessing sustainable compencies (Redman et al., 2021). However, this raises questions about the extent to which the students have truly grasped the concepts of sustainable diets and anhansed their competecis. Conducting e.g. ,a pre-post questionnaire focusing on specific sustainable diets themes would have provide a more in-depth understanding of their knowledge and progress (Annelin & Boström, 2023; Redman et al., 2021).
The items of the questionnaire were developed for this specific study and not previously validated.

Conclusion and implications for research and practice

The development and full-scale piloting of the Sustainable Diets submodule demonstrated that the students seemed to increase their competences in this topic and that the delivery of the submodule was well perceived albeit not without challenges. Our intercultural approach, in addition to the application of real-life experiences, have likely contributed to the improvement of our students' competencies in critical thinking and problem-solving.
Future use of this submodule should take into account the potential country and culturally specific challenges, especially in order to effectively facilitate activities to be carried out in local surroundings. For example, it is important to acknowledge that the handling of leftovers from grocery stores varies across different countries.
Videos of both theoretical and instructive character can complement real time digital or face to face education. The submodule can be used as it is, or parts of the curriculum can be completed as separate units in order to adapt to different subjects. For teacher education students, a major focus on why and how to implement Sustainable Diets in schools should be emphasized.
The Sustainable Diets submodule holds significant potential for future implementation, owing to its broad and generic subject matter. Furthermore, as the challenges surrounding sustainability persist, addressing these concerns will remain paramount. Nevertheless, the multifaceted aspects of sustainability underscore the necessity for an interdisciplinary approach.

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