Teaching sustainability - workshops – bridging real-world challenges from different systemic levels

Lena Krautscheid, Rhiannon Pugh, Jessica Lagerstedt Wadin, and Per Kristav, *LTH*

***Abstract*— To prepare students for addressing wicked problems such as climate change and inequality, higher education must foster systemic and interdisciplinary thinking. We developed a flexible, interactive workshop grounded in sustainability goals and transitions theory to promote abductive reasoning across disciplines. Using cases on food waste, fashion, and e-waste, the workshop was tested in four diverse settings in 2025. Findings show that while tool format (manual vs. digital) had a limited impact, structured facilitation and clearly framed tasks were essential for engagement. We offer insights for educators seeking adaptable, experiential methods to embed sustainability in diverse learning environments.**

***Index Terms*— wicked problems, sustainability transitions, transformative learning**

I. Introduction

HIGHER education needs to prepare students to address today's grand sustainability challenges, which may be described as wicked problems (Rittel and Webber, 1973) and are often open-ended, characterized by complexity, uncertainty, and ambiguity. These include climate change, biodiversity loss, and inequality, often compounded by global crises and weak governance (Wiek and Kay, 2015; Prahalad et al., 2019; Gollagher and Hartz-Karp, 2013). As these challenges grow more global and intractable, they outpace existing governance systems (Gollagher and Hartz-Karp, 2013). Notably, geography is increasingly recognized as a key discipline for studying such issues (Hawkey et al., 2019).

Yet, most current education remains siloed and discipline-bound, limiting the systemic, cross-sectoral transformation needed for deep regime-level change (Kanger and Schot, 2019; Hawkey et al., 2019). To meet these challenges, educators face the task of designing programs that build key competences for navigating wicked sustainability challenges, such as foresight, systems thinking, and ethical engagement, while students are expected to think critically, integrate interdisciplinary knowledge, and engage actively with societal issues (Davidson et al., 2020; Cross and Congreve, 2021). Digital pedagogies offer new opportunities, especially through e-learning environments that support student-centered, adaptive learning (Barth and Burandt, 2013; Davidson et al., 2020). Technology in education often uses mobile devices and apps to teach core subjects while fostering critical thinking and value-based learning essential for sustainability (Montiel et al., 2019). It can also translate complex sustainability issues into actionable insights and enable collaboration across stakeholders, though its impact on competences and behavioral change remains underexplored (Montiel et al., 2019; Azeiteiro et al., 2015).

Following Prince and Felder (2006), we argue that education must foster abductive learning and critical thinking across multiple levels and perspectives to address the complexity of real-world problems. Inspired by this insight, we developed a flexible, interactive workshop designed to introduce sustainability thinking across diverse subjects and audiences, regardless of prior knowledge. Effective teaching should clearly present relevant problems and offer experiential learning that illustrates real-world consequences (Aragón-Correa et al., 2017; Montiel et al., 2019). While diverse perspectives enrich learning, they also pose challenges, especially in interdisciplinary settings where subject identities may clash (Hawkey et al., 2019). Sustainability education requires context-sensitive approaches, as standardized models often fall short (Hawkey et al., 2019). Technology can support this by simplifying complex issues and fostering collaboration among diverse stakeholders (Montiel et al., 2019). In this paper, we reflect on the design process, explaining what worked well or not, and offer insights for educators interested in adapting or adopting this approach.

II. Design process

We present a three-dimensional workshop designed to spark discussion around grand sustainability challenges. Grounded in the SDGs and transitions thinking, the workshop addresses individual, organizational, and systemic levels, making the multi-level perspective on sustainability transitions (Geels, 2010) more tangible (see Figure 1). Using three well-known sustainability challenges, food waste, fashion, and e-waste, we conducted the workshop in four settings in 2025: (1) an international research conference (SCORAI), (2) a departmental session with faculty and PhD students, (3) a master's course on innovation at SLU in Spring 2025, and (4) a first-year design course in the technical design program in early autumn 2025 (see Table 2). In addition to testing the workshop in different settings, we also used these four opportunities to adapt and improve the workshop, learning as we went along and in turn equipping ourselves to be better workshop moderators, a pedagogic tool we have received little formal training in, with much of our pedagogic training focusing more on lectures, examination, course design and more formal elements of teaching. Introducing students to wicked problems offers a valuable opportunity to

Lena Krautscheid (e-mail Lena.Krautscheid@design.lth.se) is a PhD student in Transformative Innovation at Sparbanken Skåne's Centre for Sustainable Enterprising and the Department of Design Sciences.

Rhiannon Pugh (e-mail Rhiannon.Pugh@circle.lu.se) is Senior Lecturer at the Department of Design Sciences.

Jessica Lagerstedt Wadin (email Jessica.Wadin@design.lth.se) is an Associate Professor in Innovation Engineering, ETP, and head of the Department of Design Sciences.

Per Kristav (email Per.Kristav@design.lth.se) is a lecturer at the Department of Design Sciences.

build their capacity to address the complex issues they are likely to encounter in the future (Hawkey et al., 2019).

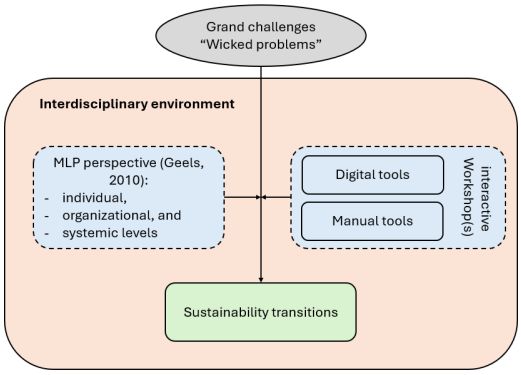

Figure 1. Overview of the workshop design.

The workshop was designed to begin with a set of warm-up questions using Menti to encourage interactive communication among the participants, followed by a brief introduction of the concept of circular economy, with the intention of exposing participants to how sustainability challenges emerge. This served both as a reminder for those already familiar with the concepts and as a first exposure for others, covering closed-loop systems and circular strategies as ways to address these grand sustainability challenges. Before presenting the three well-known sustainability challenges, the workshop included a quiz via Menti with open-ended and multiple-choice questions to activate participants' thinking and engagement (see Table 1).

Table 1. Overview of the sustainability quiz

Challenge	Questions	Type
Food waste	Can you name some examples of food products made from by-products or waste flows (e.g., coffee grounds for mushroom farming, etc.)?	Open Ended
	What would motivate you to try food products made from by-products or waste flows?	Multiple Choice
Fashion	What percentage of the clothes and shoes, etc., that you purchase are second-hand?	Multiple Choice
	What is the main barrier for you in purchasing second-hand fashion?	Open Ended
	For you, what were the main reason(s) not to make a sustainable choice when buying a product? (e.g., price, convenience, design, brand, attractiveness)	Open Ended
E-Waste	How many old mobile phones do you have in your drawer?	Open Ended
	Why haven't you returned them for recycling?	Multiple Choice

To transition into the core interactive component, participants were presented with a one-page fact sheet outlining key sustainability challenges across the three focus sectors, serving to ground the subsequent group discussions in a relevant context. Participants were then divided into small groups and guided through a structured three-step activity using flipcharts and color-coded Post-it notes.

First, each group was tasked with envisioning what sustainable consumption might look like within their assigned sector. Their ideas were recorded using post-its of a designated color to visually represent the ideal scenario. The second step involved identifying the primary consumer-related barriers that hinder the realization of this scenario. These barriers were documented using a different color of post-its, with the intention of mapping them to the previously defined ideals. Finally, participants proposed potential solutions to overcome the identified barriers, again using a third color of post-its to facilitate visual matching across all three stages.

Each step was allocated approximately ten minutes, allowing sufficient time for discussion while maintaining momentum. This activity was designed to promote collaborative problem-solving, critical reflection, and the integration of diverse perspectives within a structured pedagogical framework.

III. Result

The sustainability workshops were non-mandatory and provided open environments for participants to collaborate, besides their usual work or education setup. Additionally, they invited participants to critically think about the introduced sustainability challenges, giving both room for individual reflection but also collective discussions. Particularly in the conference workshop and the sustainability seminar series, participants had the opportunity to apply interdisciplinary knowledge to the challenges. While both student workshops were voluntary and integrated into their respective educational programs, the workshop with SLU master's students particularly benefited from the diverse academic backgrounds of participants, such as dieticians and agronomists, which enriched the discussion around the complex issue of food waste. Insights into the various workshops are presented in the following subsections, showing four different environments that enhance sustainability thinking.

A. SCORAI workshop

The workshop was attended by 14 participants, ranging from all academic levels, industry, and entrepreneurs. Most came from Europe (12), but participants from Australia (1) and Latin America (1) were present. The focus of this workshop was on all three sustainability challenges: Food waste, Fashion, and E-Waste.

Table 2. Overview of the sustainability workshops conducted, bridging real-world challenges from different systemic levels

Type of Workshop	Number of participants	Type of participants	Tools used	Manual/Digital	Date
SCORAI workshop	14	Designer, Lecturer, PhD, Researcher, Postdoc, Student, Industry	Flipcharts, post-its, Menti	Both	08.04.2025
Sustainability seminar series	12	Researchers and PhD students	Flipcharts, post-its	Manual	28.04.2025
Master course (SLU)	3	Master students	Menti, Miro	Digital	28.04.2025
Design course (LTH)	5	Technical design students	Flipcharts, post-its	Manual	11.09.2025

A. Sustainability seminar series

Approximately 12 participants from the Department of Design Sciences at LTH were present. In the workshops, all three sustainability challenges were discussed.

B. Master course SLU

The workshop was added as a voluntary activity to the course "Consumer Behavior" of the Sustainable Food Systems master's program at SLU. Therefore, from the already small number of students in the course, three students participated together with their course leader. This workshop was held entirely digitally, making use of the tools "Menti" and "Miro" to facilitate interactive and group work. Due to the students' background in food science and the limited number of participants, the focus was on the sustainability challenge of food waste.

C. Design course LTH

This workshop was designed similarly to the sustainability seminar series, using only manual tools. Due to the limited number of participants, the organization team decided to focus on one sustainability challenge: fashion.

IV. What worked well

Reflecting on the workshop, it became clear that its success was largely due to the active participation of participants. The workshops also benefited from participants with diverse backgrounds, which enabled a more interdisciplinary discourse. We were able to conduct the sessions within different time frames, ranging from one hour (e.g., the Sustainability Seminar Series and SLU master course) to two hours for the other workshops. This flexibility allowed us to adapt the format to different settings, such as offering a lunch break session or integrating it into a conference.

We observed that both manual and digital tools worked well, individually and in combination. However, since only one workshop was held fully digitally with a small group, it remains an open question how this format would scale to larger groups. Finally, the composition of our organizing team played an important role. Coming from diverse fields, such as agriculture, the social sciences, and engineering, we contributed our expertise to support the discussions.

V. Lessons learnt

While the workshop gave us valuable insights into how to approach wicked problems, we also identified several areas for improvement in its design. First, due to the small number of participants, we could not cover all the sustainability challenges in every session. Similarly, the voluntary nature of participation meant that fewer students attended than were originally enrolled in the courses. We also noticed that in larger groups, more outspoken or high-performing participants tended to dominate, while quieter or more introverted participants had fewer opportunities to contribute their ideas. In contrast, smaller groups made it easier for everyone to share their ideas and thoughts.

VI. Conclusions and context

We tested both manuals and digital tools, finding that tool choice mattered less than creating an open, well-framed space for discussion of challenges at different systemic levels. A clear task and structured facilitation proved key to engaging participants across levels of sustainability thinking.

Acknowledgment

We would like to thank all workshop participants at the SCORAI conference, the Sustainability Seminar Series, and the student courses. We are especially grateful to the course leaders for inviting us to integrate the workshop into their teaching.

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