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The grateful eight: perspectives on higher education affordances and tensions and didactics role in enhancing learning experiences towards sustainability

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Sustainability actions have the potential to exert a lasting impact on higher education didactics. Universities are often regarded as key actors in educating the next generation of decision-makers who are capable of making more informed choices from a sustainability perspective. However, significant challenges remain regarding the understanding about how sustainability can be integrated into higher education, and disciplines differ considerably in how they engage with the topic. To address these issues, we employ collaborative auto-ethnographic approach to examine how eight lecturers from different disciplinary backgrounds approached sustainability education, and what affordances and tensions they encountered during and after a joint international course on Higher Education Didactics for Sustainability organized by Karlstad University in Sweden. The findings indicate that substantial challenges persist, despite participants' high levels of motivation and transdisciplinary mindsets. These challenges appear to be linked to disciplinary differences in approaches and emphasis regarding which aspects of sustainability education are considered applicable to the participants' teaching practices.

KEYWORDS
affordances, didactics, HEDS, higher education, STEM, sustainability, tensions, transdisciplinary teaching approaches

1 Introduction

Higher education institutions have been proposed to have an essential role in sustainability since they are agents for both the knowledge for future leaders (Žalėnienė and Pereira, 2021) and suggested to be important drivers for the achievement of implementation of the United Nations Sustainable Development Goals (SDGs) (Chankseliani and McCowan, 2021). One of the goals (SDG 4) focuses on equal access to education and includes education for sustainable development in SDG 4.7.

The focus on education for sustainable development is urgent due to climate change. There are also several economic and geopolitical crises going on. The year 2024 was the warmest year recorded, and the year 2025 is just slightly close behind (WMO, 2025). Even though new innovations have been developed, and people are focusing on sustainability issues, there is an underlying awareness that unlimited growth on a limited planet is not a realistic option (Rockström et al., 2024). This then highlights the need for future generations to do things differently and to come up with solutions, which could ensure a just transition into a more sustainable future.

In the education of new generations, higher education plays an essential role. However, higher education has also been proposed to stand for critical thinking and academic freedom, which implies different views on teaching sustainability. Shephard and Furnari (2013, p, 1581-1582) identified for example four different viewpoints among academic staff on Education for Sustainable Development (ESD), one of which promotes ESD and three of which do not: group 1—Advocates for sustainability and for integrating sustainability into higher education, group 2—University teachers committed to the liberal ideals of higher education in disciplinary contexts, group 3—Sustainably minded university teachers inclined towards interdisciplinarity but not 'education for sustainability' and group 4—Anthropocentric university teachers mindful of their academic freedom and responsibility to be critic and conscience of society.

Previous research about teacher perceptions related to ESD shows diverse results in different countries (Biasutti et al., 2018). In Pakistan for example a study showed that teachers in general had inadequate knowledge of sustainability (Saqib et al., 2020). In the USA, within a specific faculty—art and design—the teachers had high confidence in teaching sustainability (Kang et al., 2024). Goller and Rieckmann (2022) conducted a systematic literature review to explore what we know about teacher educators' (teachers that educate other teachers) perceptions of ESD in higher education and found a limited number of articles (e.g., 12). The findings revealed that the teachers' attitudes towards ESD were mainly positive. However, some teachers did not find it necessary to include ESD in their education since they thought that the students already were well informed about sustainability aspects (Goller and Rieckmann, 2022). Different teachers' perceptions on ESD are of importance depending on their disciplinary approach since this might have implications for both teaching and learning about sustainability in higher education.

Georgiou et al. (2021) highlights that teachers' disciplinary backgrounds shape their perceptions of environmental concerns, which helps explain why educators in natural and environmental sciences tend to be the most engaged in sustainability-related activities. This pattern may also hold for higher-education teaching staff more broadly, whose involvement in sustainability often reflects their academic training — a tendency that appears to be confirmed by scholarly contributions (Cotton et al., 2009; Leal et al., 2024). Research also explains how science, technology, engineering and mathematics, or STEM disciplines would benefit from the views from social sciences, humanities and the arts, or SHAPE disciplines to enhance their abilities to tackle sustainability questions (Chakraborty et al., 2025; Horvath et al., 2023; Marcone, 2022). However, we know less about the affordances and tensions surrounding different disciplines focusing on education for a sustainable future.

The aim of this paper is to capture and analyse affordances and tensions between eight different disciplinary perspectives on 'Education for Sustainable Development' (ESD) in higher education. However, the paper will also address the teacher´s background with motivation/starting values and how to handle challenges and new ways to implement Higher Education Didactics for Sustainability (HEDS). This paper is written by eight teachers from different disciplines that met through participation in an online course on higher education didactics for sustainability (HEDS251, 2025) and includes the following overall research question:

> *How do teachers from different disciplinary backgrounds perceive and navigate the affordances and tensions of Education for Sustainable Development (ESD) in the context of the HEDS course?*

The remainder of the paper is structured as follows. In Section 2, we present the frame of references in terms of (i) challenges, (ii) sustainability competencies and (iii) holistic and transdisciplinary opportunities. In Section 3, we discuss the methodological choices, and Section 4 includes the findings. Further, in Section 5 the discussion is presented and finally Section 6 offers our conclusions and implications for our findings together with suggestions of future research avenues.

2 Frame of references

2.1 Challenges

A central challenge in higher education didactics for sustainability is the differences between distinct epistemic cultures, such as STEM and the humanities. In the STEM disciplines, sustainability is often approached through an emphasis on evidence, measurement, and technological innovation. These fields tend to focus on factual accuracy and the pursuit of objective, replicable knowledge, providing powerful tools for understanding environmental systems and developing practical solutions (Sterling, 2010). Such fact-oriented stances can sometimes overlook the social, ethical, and cultural dimensions of sustainability. The humanities, by contrast, approach sustainability as a deeply interpretive and value-laden enterprise that often becomes much more political. Here, sustainability is not only about what we can measure but also about how we ought to live, what we value, and which futures we consider just or desirable (Jickling and Wals, 2008). This opens space for reflection on power, ideology, and the moral implications of human action and is often critical of our current systems. This may introduce tensions, as teaching and research in the humanities can become entangled with political and formative positions (Wals, 2020). The interpretive and critical strength of the humanities may thus be perceived, especially from a STEM perspective, as overly subjective or ideologically driven (Leicht et al., 2018). To put this in a wider perspective, arts may add yet another perspective by focusing on affect, imagination, and sensory experience to the equation. Artistic approaches may invite emotional engagement expecting students to explore sustainability through creativity and expression rather than rational analysis alone (Inwood and Taylor, 2012).

A persistent challenge in higher education for sustainability lies in how institutions and governing bodies assess and demonstrate their own contributions to sustainable development. Universities are increasingly expected to document progress through sustainability reports, rankings, and performance indicators that align with global frameworks such as the United Nations' Sustainable

Development Goals (SDGs). Rather than applying fragmented sustainability goals within rigid silo structures, action for sustainability needs to be coordinated among academic actors both horizontally and diagonally, which requires spaces for strategic thinking, concertation, open discussion and knowledge sharing. (Avery and Nordén, 2021). While these instruments aim to enhance transparency and accountability, they often prioritize measurable and standardized outcomes, such as carbon reduction targets, curriculum integration rates, or the number of sustainability-related courses offered (Tilbury, 2011). This emphasis on quantifiable data risks narrowing the understanding of what sustainability in higher education entails, favoring managerial and procedural indicators rather than "real" change (Adams et al., 2018). The push for measurable outcomes may inadvertently privilege disciplines and initiatives that produce visible metrics in line with predetermined goals. These institutional assessment practices are further shaped by global sustainability agendas that often reflect current policy logics, raising questions about how well they resonate with diverse regional and local contexts (Mochizuki and Fadeeva, 2010). Institutions in different parts of the world operate within varying social, economic, and ecological realities, making the application of global indicators both uneven and sometimes counterproductive. The tension between globally comparable benchmarks and locally meaningful action thus presents a major didactic and strategic dilemma. While global frameworks provide legitimacy and shared purposes, they can constrain universities' capacity to develop sustainability strategies grounded in local knowledge systems, community partnerships, and place-based pedagogies (Leal Filho et al., 2018). Assessing sustainability outcomes in higher education requires more than collecting data; it demands critical reflection on whose definitions of success are being used.

2.2 Sustainability competencies

Sustainability competencies in higher education form a crucial foundation for preparing graduates to tackle complex environmental, social, and economic challenges (Redman and Wiek, 2021). A wealth of scholarly literature offers invaluable insights which have evolved along two main strands: frameworks that establish foundational concepts, and critical perspectives that challenge and deepen understanding.

Among the most widely referenced frameworks in sustainability education is that of Wiek et al. (2016), which identifies six key competencies essential for advancing sustainability transformations. Building upon Wiek's work Brundiers et al. (2021), expanded and refined these competencies through expert consensus, introducing two additional key competencies and emphasizing the integration of values-thinking. In brief, this framework identifies eight core competencies: systems thinking, anticipatory, normative, strategic, interpersonal, intrapersonal, integration, and implementation of competencies. These competencies equip students to understand complex interactions across systems, envision potential futures, engage in ethical decision-making, collaborate effectively, reflect on their own roles, integrate knowledge, and translate ideas into action. Complementing this, (Nordén, 2024) emphasizes how higher education should foster future-oriented competencies that enable students to navigate the uncertainties and complexities of sustainability transitions. She advocates for pedagogical approaches that move beyond knowledge acquisition towards cultivating transformative capacities in learners.

On the other hand, critical perspectives enrich this discourse by questioning the dominant competency-based paradigm. Propose applying critical lenses to sustainability education to avoid perpetuating unproductive or harmful attitudes. They call for awareness of the power dynamics and assumptions embedded in sustainability discourses. Lotz-Sisitka et al. (2015) argue that higher education should challenge the resilience of unsustainable systems by fostering transformative, transgressive social learning. They emphasize that sustainability education needs to go beyond building incremental competencies to actively dismantling systems that undermine social and ecological well-being.

Furthermore, and given the fact that education for sustainable development (ESD) seeks to shape pedagogies that are inclusive, participatory, and transformative (UNESCO, 2017; Biesta, 2011), it inherently promotes democratic values. These pedagogical priorities align with the essential dimensions of democracy by fostering critical thinking, dialogue, shared responsibility, and inclusive learning environments that empower learners as agents of change within democratic societies (Westheimer and Kahne, 2004).

However, bridging sustainability competencies and democratic dimensions requires acknowledging the institutional contexts that shape education. Between societies and schools lies an intermediate layer called the noosphere—an institutional framework guiding education's organization and future direction (Bosch et al., 2020). The noosphere, understood as a sphere of reason, integrates scientific, ethical, and spiritual dimensions into education, fostering planetary citizenship, holistic thinking, and ethical responsibility beyond mere knowledge transfer (Samodryn, 2023). This framework situates schools within a broader societal and civilizational context, emphasizing that education must respond to localized cultural and historical realities while addressing global challenges.

2.3 Holistic and transdisciplinary opportunities

These cultural and historical realities also can be related to both affordances and tensions in the learning environment. Thereby, we need a more holistic transdisciplinary approach within the HEDS implementation. Noospheres thinking for educational development of models and concept chains can be used in this development.

Systems thinking and values thinking facilitate re-consideration through a conceptual chain model catalyzing the visibility of noospheres thinking (consciousness, reflection, reason and mind). Various conceptions of the noosphere share the common thesis that together human reason and scientific thought have created, and will continue to create, the next evolutionary "knowledge formation" layer (Fuchs-Kittowski and Krüger, 1997). In the context of sustainability and higher education, this layered model helps us understand how educational practices, especially in mathematics and other disciplines—are shaped not only by schools and societies but also by overarching civilization values and institutional visions (noospheres). Teaching for sustainability, therefore, must be transdisciplinary and responsive to these multiple levels, integrating insights from various subjects to prepare students for complex global challenges.

Transdisciplinary teaching approaches have been investigated and proved catalyzing the implementation of sustainability didactics (Nordén, 2018) in Swedish upper secondary schools. The eight perspectives of higher education sustainability didactics in this study are

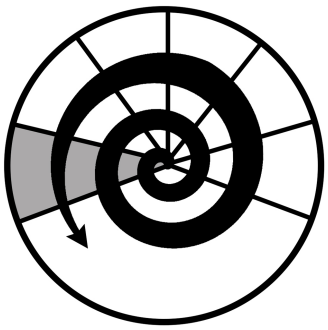

FIGURE 1
Additive and subject-based teaching approach (Nordén, 2018).

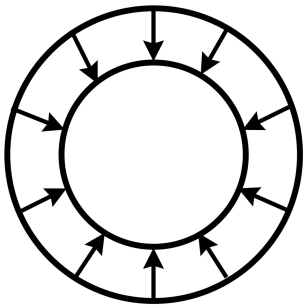

FIGURE 2
Phenomenon-based teaching approach combined with holistic and transformational strategies (Nordén, 2018).

explored and discussed with reference to transdisciplinary teaching approaches. Figures 1 and 2 illustrate two different transdisciplinary teaching approaches as interpreted in connection to the didactic focused data analysis (Nordén, 2018).

Figure 1 visualizes category 1 as an additive and subject-based teaching approach. The different disciplines/school subjects are experienced as part of sectors, undergoing a spiral process of a mutually enriching disciplinary exchange. Figure 2 visualizes category 2 as phenomenon-based, combined with holistic and transformational strategies.

Contributions from different subjects are experienced as interconnected perspectives on the same larger global–local phenomena. Subjects were in the latter case pedagogically conceptualized within an understanding of how teaching and learning, global dimensions and sustainable development are interconnected. This could diminish the disciplinary tensions and form the foundation for the transdisciplinary teaching experience (Nordén, 2018). By recognizing affordances of inter- and transdisciplinary collaboration as urgent and rewarding, in this time of uncertainty, self-efficacy and self-regulation based on the individuals' commitment, could play an important role in teachers' HEDS practices.

The reasoning above can be compared to the noosphere thinking, and a noosphere can be understood as a postulated sphere or stage of evolutionary development dominated by consciousness, the mind, and interpersonal relationships, according to Teilhard and Vernadsky (Fuchs-Kittowski and Krüger, 1997). As scientists, they "overstepped" the boundaries of the natural sciences and attempted to create all-embracing theoretical constructions founded in philosophy, the social sciences and authorized interpretations of the evolutionary theory. They also argued that human activity becomes a power and that how it is directed can influence the environment (seen in a wider and deeper meaning including geo-, atmos-, bio- and noospheres), according to Fuchs-Kittowski and Krüger (1997).

3 Method

3.1 Overall design

This study was driven by a bottom-up approach and empirical interests that were discovered during a course on sustainability in higher education. Overall, the study was conducted to understand how different disciplines approach sustainability in higher education. To paint a full picture, we needed to understand different layers regarding the participants, since there are three main aspects to consider: our individual motivations and thoughts, our disciplinary background and the topics that were taught to us (see Figure 3). By looking at these and then the main learning outcomes, which we identified, we can show in practice how different types of individual and disciplinary approaches shape what we consider important learning outcomes from the course. To better understand these aspects, we utilized collaborative auto-ethnography as an approach (Ellis et al., 2011), since it allowed us to express our individual perceptions as well as position ourselves as learners among our disciplines (cf. Chakraborty et al., 2024). It is also important to realize that not all our colleagues share their thinking with us, so it was first important to position ourselves regarding our motivation. Furthermore, we also explore how affordances and tensions shaped our thinking, when we worked as a multi-disciplinary group together.

As can be seen, the paper approaches the disciplinary differences from two aspects; first on the overall effects of disciplines and their role in shaping the learning outcomes, second the multi-disciplinary aspects, which also helps in developing varying views to ESD, which enabled new types of learning among the group participants.

3.2 Participants and contextual background

The subjects of the study formed a mutual learning group for the Higher Education Didactics for Sustainability, or HEDS-course (2025) and originally the group consisted of more than eight members. However, some of the early participants gradually left the course without completing it and therefore their role has not been studied. From the eight participants (who successfully completed the course), three represent the STEM disciplines (Civil and Transport Engineering and Economics, Mathematics Education, Surgical Sciences Functional Pharmacology and Neuroscience) and five participants represent the SHAPE disciplines (Business Administration, Communication Sciences, Humanities, Language, Science Education and Educational Sciences, Regional Studies). The participants in this study come from Finland, Greece, Poland, Portugal, and Sweden. The course participants were originally picked into the group at random, so the group did not choose the participants, nor decided between focusing on certain disciplines. On the contrary, the idea of the HEDS course was to learn in multi-disciplinary setting, which meant mixing different disciplines together.

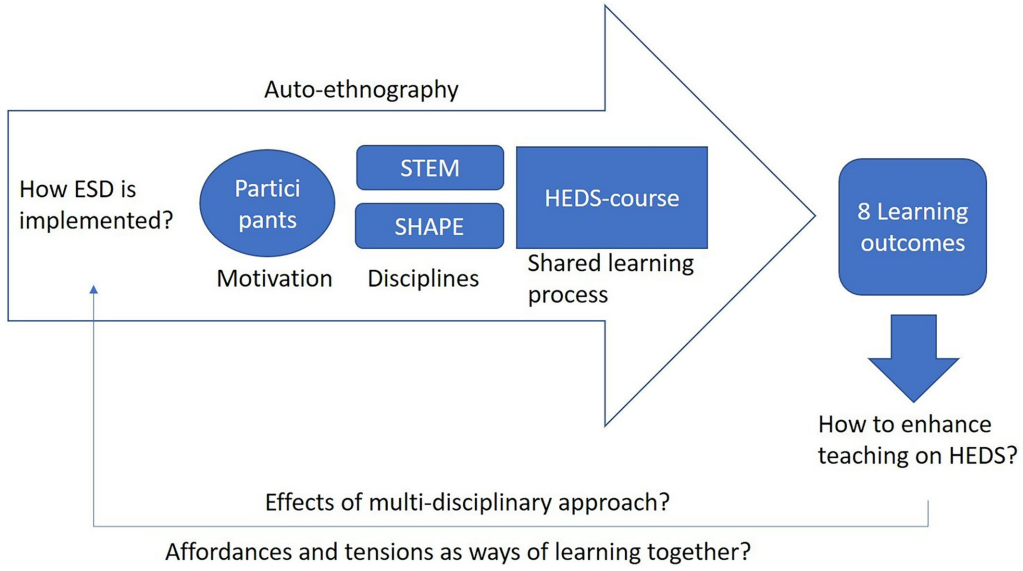

FIGURE 3
The overall study approach.

All the individuals were motivated to join the course, since it offered them no credit, nor other benefits, except for learning from the course contents together with others. This means that for all the participants the course was both voluntary and presented them with additional tasks. This shows that the individuals were motivated to engage with the topic.

The course lasted from January to April in 2025. During those 4 months the course had five topics: (i) Connecting to the world and each other, (ii) Competencies, frameworks and curriculum, (iii) Didactic approaches to teaching and learning in ESD, (iv) The role of university and (v) Lessons learned and future practice. Each of these sections consisted of lectures for all course participants, related reading material, as well as individual and group assignments. The materials focused on UN sustainability teaching goals, like sustainability (by Brundiers et al., 2021), inner development goals (by Nordén, 2024), and climate emotions wheel (Climate Mental Health Network, 2025).

3.3 Data collection and analysis

In this paper, a collaborative auto-ethnography approach, a qualitative research method, was used to capture eight stories from eight researchers' personal experiences taking part in the HEDS course. Sometimes an auto-ethnographic approach (Ellis et al., 2011) receives critics for ethical reasons which the collaborative auto-ethnography approach may resolve (Lapadat, 2017). Since, in contrast to traditional auto-ethnography, it leverages dialogue and multi perspective analysis.

In our research, the accounts of personal experiences were followed by a process of meaning-making carried out both collectively and individually. We found this especially effective for our research aims as its collaborative and iterative nature helped us explore the methodological and ethical issues linked to researcher reflexivity including the subjectivity inherent in solo auto-ethnography (Chang et al., 2013). Each researcher wrote a story based on their own perspective in their own discipline with its activities. As inspiration the following questions were used (Figure 4).

The analysis was conducted in two steps. The *first step* was inspired by Gioia et al. (2013). Gioia et al. underlines the importance of giving "voice to the informants in the early stages of data gathering and analysis" (Gioia et al., 2013, p. 17). The goal is to demonstrate "the connections among data, the emerging concepts, and the resulting grounded theory" (Gioia et al., 2013, p. 17), but without losing qualitative rigor. To do this, we considered 1st and 2nd order analysis which means that in the 1st level codes emerge from the terms used by the informants, while at a second order analysis it will be possible to identify concepts, themes and dimensions by the researchers. Finally, these themes were aggregated in the 3rd stage of the analysis, as seen in Figure 5 as an example of this process.

We chose two themes for this analysis: (i) 'Motivation' for taking part in the course HEDS and (ii) 'Starting values' which represents what each researcher brought with them in terms of into the course. The data material is presented in Appendices I ('Motivation') and II ('Starting values').

Given the priority to explore the enhancing learning experiences among lecturers, these were analysed in two steps: the collective and the individual. The *second step* was carried out through a contextual analysis (Svensson, 2004, 2020) focusing on the individual perceptions of the content in the HEDS course. Similarities and differences were analysed to find qualitatively different ways to experience the HEDS course learning process (Marton and Booth, 1997). The analysis aimed to create understanding of these by abstracting the data into qualitatively distinct categories of content descriptions (cf. Svensson et al., 2007) and thereby comparing the different stories and individual learning experiences with each other besides relating them to all the categories of content descriptions recognized. An individual teacher might contribute to more than one category, while each category may be constituted from statements made by several teachers. The findings might be considered additionally sustainable, because of the critical reflection and analysis in the joint learning process, according to Svensson et al. (2007), who also argue that the inclusion of the participants in the whole research process is a way to increase the validity of the research.

1. What is your title and main research and education subject?
2. How did you arrive here at the course?
    a. What made you apply?
    b. What needs did you have?
    c. What were your expectations?
    d. Did you have any concerns, if so, what were they?
3. What were your starting values?
    a. What knowledge did you already have about sustainability as a subject area or as an educational practice?
    b. What did you apply regarding sustainability in your classroom?
4. Affordances and tensions
    a. What was most beneficial to you in participating in the course?
    b. What were the main challenges?
    c. Did you experience any tensions subject wise or in the group process, describe them.
5. In what ways are you going to implement new ways of teaching sustainability in your education?
6. What more knowledge do you need in terms of competence, didactic skills or tools?

FIGURE 4
Questions as inspiration for the stories.

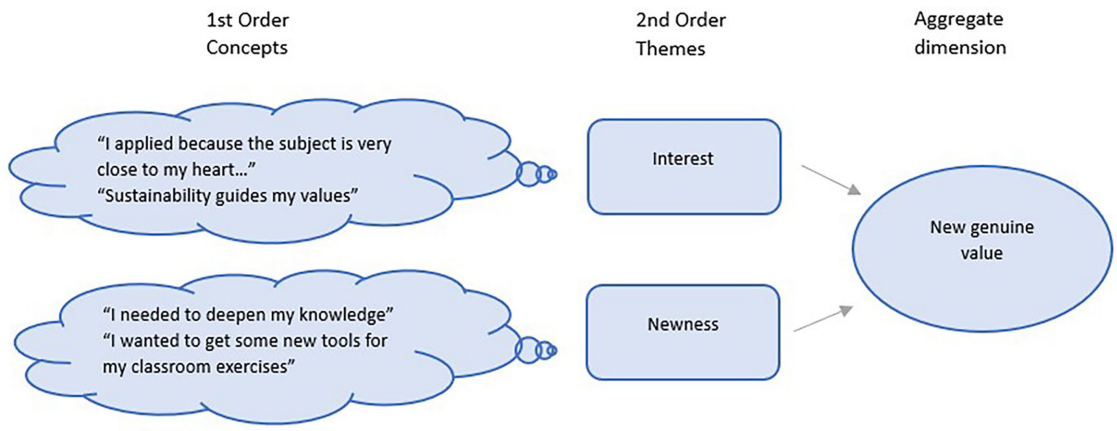

FIGURE 5
Example of data analysis inspired by Gioia et al. (2013), theme 'Motivation'.

4 Findings

The findings are divided into two steps in line with the analysis. First, we present the result of the thematic analysis inspired by Gioia et al. (2013) labelled *Collective background* (4.1) with the two themes 'Motivation' and 'Starting values' (cf. Braun and Clarke, 2006). Thereafter, we present the result of the contextual analysis (Svensson, 2004, 2020) of the content and the learning experiences according to Marton and Booth (1997) labelled 'Perceptions—individual thinking' (4.2). The perspectives recognized are 'Challenges', 'Key competencies', 'Inclusion in higher education' and 'Affordances and tensions'.

4.1 Collective background

4.1.1 Motivation

The motivational aspects for taking part in the course HEDS have several similarities between the eight researchers. Altogether it is shown that all eight participants wanted to gain new knowledge, which is not surprising. The aggregated dimension of New genuine value is based on newness in terms of both the aim of achieving new knowledge but also explicit to have new tools related to sustainability aspects in the classroom. In addition, it was a longing for change and to develop a pedagogical perspective on sustainability. The genuine aspect relates to a core value in the researchers' wish for new knowledge related to sustainability.

> *- I applied because the subject is very close to my heart…- Sustainability guides my values… In general, I wanted to broaden my horizons regarding the concepts of sustainability, and I saw this course as a valuable opportunity to do so, while also strengthening my pedagogical qualifications. - My motivation to participate in the HEDS course was the feeling that I needed to change the way I teach and adapt my teaching context to new environmental, societal, and economic challenges.*

Another motivation for participating in the HEDS course was to gain Better connections. These connections relate to the links between practice and theory as well as integration and inclusion of sustainability per se with the own education and research subject.

> *-…build bridges between practice and theory, - Although sustainable development is a recurring theme in both curricula, its connection to mathematics is not clearly articulated in either the*

> *syllabi or the accompanying commentary materials, - this difficulty has led me to look for other ways to integrate the multiple issues associated with sustainability.*

It was also obvious that some of the researchers wanted to work together with others to a larger extent, which led to the aggregated dimension Co-creation delivers. This means that there could be more possibilities to work with sustainability together than working alone in the development of sustainability aspects in the classroom. It could also be related to the fact that within their own subject there are too few colleagues interested in sustainability aspects.

> *-My motivation to participate in the HEDS course was the feeling that I needed an extended network for advancing HEDS knowledge formation to exchange and develop, -…receiving input and insights into the practices and visions of other colleagues in the training. - particularly given the opportunity to engage with the topic through a collaborative form…*

Finally, the aggregated dimension Importance for the future is based on expressions related to how important the universities' role is for future development and the possibilities to make long-term impact (cf. Wade-Benzoni, 2019; Wade-Benzoni et al., 2012).

> *-I also did know that universities are in a critical role in teaching future leaders and experts, -so I knew that our teaching could have a long-term impact for the world, if we know how to do it right.*

4.1.2 Starting values

There are several aspects that serve as starting values and represent the knowledge, competencies and skills the researchers brought with them on the course. All the researchers had for example some experiences and knowledge about Sustainability and circularity related to their own discipline.

> *-I already had some knowledge about sustainability and circularity, -I had already participated in a course on education for sustainable development (ESD)* – "Introduction to ESD"

They had also started up education about sustainability in the classroom which led to the aggregated dimension of educational didactics. This included both an overall perspective of sustainability and more details about, for example, Earth Overshoot Day. They also reflected on how the didactic practices could be handled in the classroom.

> *-I had already been working on some sustainability projects, and had lectured about the topic itself in my classrooms, -I had already started integrating topics such as resource scarcity, Earth Overshoot Day, ecological and biodiversity footprints, doughnut economics, and the ethical dimensions of economic decisions inspired by Amartya Sen into my teaching., - I had already been working on some sustainability projects, and had lectured about the topic itself in my classrooms, but did not know how one can have sustainability perspective as guiding my pedagogical approach.*

Overall, critical thinking about Ethical values was part of the starting values for the participants. The understanding that if we will not think about and act according to values related to sustainability/circularity—nothing will happen.

> *-If you don't have the core values and intentions that relate to a sustainable or circular way of thinking and acting, there will be less sustainable and circular activities. - However, my views on economic development, especially in developed countries, have recently changed. I now see the need to shift consumption models and ensure a more equitable distribution of resources.*

The notion that many aspects are linked together is also evident and the aggregated dimension.

Togetherness shows the various connections and links between both interaction in networks and communication in general.

> *-I have come to understand that sustainability is increasingly emerging as a significant and interconnected aspect of internationalization practices and education as well. -In the case of sustainability communication, it's important to note that it refers not only to internal and external communication within organizations, associated with management and administrative functions, but also externally, in contact with the public and consumers in the form of multiple stakeholders.*

It is also evident that there is a longing for practical change in society among the participants. This relates to the Applied policies and the Technological praxis.

> *-Technologies like renewable energy, circular production models, water purification systems, and sustainable agriculture play a key role in reducing ecological footprints and the pros and cons of each solution are very interesting topic.-My understanding of sustainability has always been rooted in technical and practical solutions, where pragmatism is key to achieving real progress. - I realize that I had been focusing more on the technical aspects of the processes and their economic benefits, rather than addressing the broader context of recycling within the framework of the circular economy.*

4.2 Perceptions—individual thinking

4.2.1 Challenges

Participants representing SHAPE disciplines acknowledged that traditional teaching methods are insufficient to address today's sustainability challenges and that there is a need for support and tools to implement education for sustainable development.

> *- There is a need for a website that brings together not only the knowledge, teaching skills and tools needed for teachers to work in this field but also examples of good practice. By doing so, it would be possible to reduce the time wasted looking for them and sharing experiences, making this work less solitary. Each field of knowledge has contributions and practices that can be very valid, so it would be useful for such a site to bring together these contributions, both*

> *in terms of data and in terms of theory, theoretical framework and conceptual framework.*

Representatives of STEM disciplines also experience a lack of support, for example, the national mathematics curricula in Sweden include sustainability as a broad educational goal but do not provide explicit links between mathematics and sustainability content. As a result, mathematics teachers are left without structured guidance on how to incorporate sustainability topics into their lessons.

SHAPE representatives felt the need for more interdisciplinary approach. One participant noted a disconnection between scientific communication and emotional engagement, which highlighted the necessity of reaching far beyond his own discipline to include insights from psychology and pedagogy (cf. Öhman and Sund, 2021). Another participant, in turn, pointed out institutional barriers to transdisciplinary education and systemic thinking. Some STEM representatives underlined the need to incorporate sustainability into teaching while trying to maintain scientific rigor, avoid politicization, and meaningfully contribute to sustainable systems through innovation and evidence-based method. This on the other hand led to some tensions.

> *- I sensed a certain clash between the social sciences and humanities and the exact sciences, particularly on the topic of empowering students to be agents of change: there were those who argued that you can't mix politics and science.*

4.2.2 Key competencies

An important aspect of the HEDS course was the emphasis on key competencies that students need to develop, in order to effectively implement sustainability for the future. These competencies, as presented in Wiek et al. (2016) and Brundiers et al. (2021), include systems thinking, strategic and futures thinking, intra- and interpersonal competencies, and implementation competency, all of which contribute to integrated problem-solving competency. As one participant observed:

> *-…sustainability in higher education is not (or not only) about teaching environmental protection, circular economy, or social inclusion, but about equipping students with the competencies that will enable them to act in society and become sustainability agents in the future. … key competencies needed to empower sustainability … do not directly refer to sustainability itself. Instead, they are broad academic and life skills that students should develop throughout their studies.*

Among the eight HEDS participants, four explicitly referred to key competencies for sustainability. These participants plan to integrate competencies like systems, critical, strategic and anticipatory thinking, collaboration, problem-solving, and transformative learning into their teaching. Two others addressed related ideas implicitly, focusing on critical awareness, emotional engagement, and student agency, without using formal terminology. The remaining two participants did not refer to key competencies at all, emphasizing technical knowledge, student perceptions, or disciplinary content instead (Rittel and Webber, 1973).

4.2.3 Inclusion in higher education

SHAPE representatives either had already implemented topics and approaches strongly oriented towards sustainability or at least addressed themes of sustainability and inclusiveness during their teaching activities with students (circular economy, doughnut economics greenwashing, fast fashion, UN sustainable development goals, language diversity in inclusive and sustainable education). All of these educators, following the HEDS course, plan to expand and improve their teaching practices or introduce new topics related to social, economic, and environmental issues. For those participants the changes will concern mainly the teaching approach, with a focus on developing students' key competencies and shifting from a rather passive approach focused on delivering information, towards learning by experience that encourages students to engage more in independent and problem-based tasks.

Some SHAPE representatives are deeply engaged in education for sustainable development, both in terms of content and teaching methods.

Business and administration teacher applies sustainability in her teaching through a structured, three-step approach: starting with a perception-based workshop using images, followed by a historical overview of sustainability, and concluding with analysis of current trends and research. She plans to further develop her classroom methods to better reflect students' perspectives and include stronger emphasis on circular economy thinking. Science education teacher is strongly involved with systemic design towards sustainability including creativity and innovation, future-oriented methodologies, linked to sustainable society building, critical eco-reflexive Bildung/in- and non-formal learning, and transformative teaching in higher education connecting UN SDGs to Inner Development Goals (Nordén, 2024). Regional studies teacher wants to incorporate emotional and personal engagement into his teaching of sustainability. He intends to use tools like the Climate Emotions Wheel and the IMAGINE framework to help students connect emotionally with sustainability topics, believing that personal investment enhances long-term learning.

> *- …feelings might actually be an important key in promoting sustainability perspectives in pedagogy…We may learn things, but they remain in us only if we feel something about them and thus, we keep thinking about them… This is also something, which I try to utilise in my teaching in the future; talk about the feelings that students have in order to show that they actually matter, also from a pedagogical point of view.*

STEM representatives have different approach to applying ESD. Mathematics representative is working on developing a new mathematics education module inspired by a hackathon-like workshop, which will connect real-world sustainability challenges with collaborative problem-solving. She sees mathematics as a powerful tool for sustainability-related decision-making. Another STEM teacher does not plan to use specific methods introduced during the course but feels the need to further explore the technical and scientific aspects of sustainability. His teaching is likely to focus on tools and concepts such as life cycle assessment, green chemistry, and circular production systems rather than pedagogical strategies or social dimensions (Table 1).

TABLE 1 Perspectives on challenges, key competencies and inclusiveness.

	Challenges	Key competencies	Inclusion in higher education
Participant 1 (economics and recycling)	The HEDS course lacked practical teaching methods and guidelines for competence-oriented education. Need for better didactic and pedagogical tools to support student engagement.	Emphasized competence-based education (systems thinking, critical thinking, collaboration, problem-solving, strategic and anticipatory thinking).	Moving away from passive knowledge delivery and adopting more experiential, problem-based learning methods. Plans to include place-based learning and real-world projects, rooted in the local community or campus that develop sustainability competencies.
Participant 2 (communication sciences)	Concern over the lack of integration of humanistic perspectives in some course materials. The social sciences vs. exact sciences divide.	Did not refer to the term key competencies, but emphasized developing critical awareness, responsible behaviour and media/environmental literacy.	Focus on a more holistic approach to sustainability issues and linking her participation in EcoEscolas program with classroom teaching. Wants to connect permaculture ethics and principles with classroom practices.
Participant 3 (mathematics)	Lack of explicit curricular links between mathematics and sustainability and difficulty in connecting abstract math concepts to real-world sustainability issues. Shortage of concrete examples and teaching materials tailored to mathematics education.	Referenced Brundiers et al. (2021)	Plans to design a mathematics module inspired by the Stormathon workshop, using real-world sustainability problems and collaborative problem-solving. Intends to explore more didactic strategies and assess how students engage with sustainability through mathematics.
Participant 4 (regional studies)	Disconnection between scientific communication and emotional engagement. Necessity to reach far beyond his discipline to include psychology and pedagogy. Need for more pedagogical tools that connect with students emotionally and personally.	Did not refer to key competencies but focused on emotions and personal engagement in learning.	Wants to incorporate emotional and personal engagement into teaching of sustainability. He intends to use tools like the Climate Emotions Wheel and the IMAGINE framework to help students connect emotionally with sustainability topics.
Participant 5 (English language)	Ongoing challenge of promoting linguistic diversity and inclusion. Sustainability is often overshadowed by market-oriented goals.	Referenced Brundiers et al. (2021)	Uses English language instruction to raise awareness of global sustainability issues and focuses on learner-centered and reflective learning, plans to target key sustainability competencies, and will continue to emphasize the role of multilingualism and language diversity in inclusive, sustainable education.
Participant 6 (science education)	Institutional barriers to transdisciplinary education and systemic thinking. Even motivated lecturers may lack support or tools to implement ESD. Teachers may resist change due to disciplinary silos or course overloads.	Emphasized competencies like creativity, innovation, eco-reflexivity, and transformative learning.	Plans to strengthen phenomenon-based learning that integrates both the UN Sustainable Development Goals and Inner Development Goals.
Participant 7 (pharmacology)	Navigating the divide between technical-practical sustainability and socially driven approaches, while trying to maintain scientific rigor, avoid politicization, and meaningfully contribute to sustainable systems through innovation and evidence-based method.	Did not refer to key competencies, focus on pragmatism, efficiency and scientific rigor in sustainability education.	Does not describe specific inclusion in the classroom but emphasizes a strong interest in technical and scientific aspects of sustainability, such as life cycle assessment, green chemistry, and circular production systems.
Participant 8 (business administration)	Tension between normative vs. descriptive roles of universities.	Did not refer to key competencies, focus on student perceptions.	Plans to further develop her classroom methods to better reflect students' perspectives and include stronger emphasis on circular economy thinking.

4.2.4 Affordances and tensions

Affordances were looking at what aspects the participants held the most useful in the course, whereas tensions were recognized as issues, subject wise, or from the group's process point of view. Affordances were fairly similar alongside the participants, as most of them felt that they got new insights into the subject matter and learned from the mutual dialogue, which was utilized via group work through the course. It can also be said that the participants all had some previous interest in the topic of the course, so there was willingness to learn more from sustainability as a topic. This meant the participants were motivated to learn from the course materials, but also from each other.

There were two types of tensions; one related to the participants' subject area and connections with sustainability and the second one with the concept of science itself and how universities should approach sustainability as a societal phenomenon. There was disparity between the SHAPE and STEM representatives concerning the role of universities, which manifested in discussions through the concept of "academic activism." This offered a forum for fruitful discussions about how neutral science can be and how active academics should be in promoting sustainable activities to drive society towards a direction that they aim for. This led to broader discussion on what university's role in sustainability is in general and how active they should be in training sustainable citizens for the future. SHAPE represents disciplines which have developed to study the mechanics of society, where political views and approaches are part of the "puzzle." STEM disciplines on the other hand are based on the idea of proving phenomena as either true or false, so they are looking at the world from different perspectives. To sum up, a holistic approach on sustainability subject matters is a concept that is not easy to integrate fully in either discipline's teaching. However, to enable multi-disciplinary transitions, the importance of transdisciplinary discussions could though challenging be seen as offering more perspectives on sustainability issues (Table 2).

5 Discussion

5.1 STEM and SHAPE in education didactics towards sustainability

The urgency in enhancing learning experiences among lecturers is highlighted by the recognized perspectives on higher education. The variation of ways in which contextual features were revealed affected how participants experienced their own learning and the affordances and tensions within the HEDS learning space.

This collaborative auto-ethnographic study is characterized by a continuous joint learning process between the participants at the same time individually appearing two different roles: (1) as a HEDS course participant, and (2) as an informant conducting auto-ethnographic research (Van Poeck et al., 2025). The design of this collaborative auto-ethnographic approach with inclusion of the participants in the whole research process is a way to increase the validity of the research, according to Svensson et al. (2007). Then, the outcome of the research in terms of new concepts or theories, didactical development and change processes might through the process of participatory action research (Kemmis, 2009; Kemmis et al., 2014) be experienced as owned by the participants, i.e., the researching lecturers. Consequently, the local context and the process for HEDS were characterized by the learner's perspective and self-efficacy, including challenges, critical reflection and analysis in the joint learning process.

The analysis demonstrates that disciplinary epistemologies strongly shaped how participants approached sustainability education, particularly along the STEM–SHAPE divide. Participants from STEM-oriented traditions often engaged with sustainability through problem-solving logics, technical feasibility, and a desire for clarity in learning outcomes, reflecting what Becher and Trowler describe as "hard" disciplinary cultures with relatively stable epistemic norms (Becher and Trowler, 2001). In practical terms, this meant that several STEM participants initially struggled to relate the course material to their own teaching contexts, expressing uncertainty about how dialogical, reflexive, or normatively oriented pedagogical approaches could be meaningfully operationalized within their disciplines. By contrast, participants from SHAPE-related disciplines tended to approach sustainability as an inherently value-laden and contested field, emphasizing critical reflection, ethical considerations, and societal transformation. For these participants, the course material largely resonated with existing pedagogical practices and theoretical traditions, which was reflected in their early enthusiasm and active participation in discussions.

5.2 Affordances in the learning process

These contrasting orientations illustrate how sustainability education is interpreted differently depending on disciplinary cultures and knowledge traditions. Sustainability appeared, for some, as a set of solvable challenges requiring better tools and methods, while for others it was primarily understood as a question of meaning-making, power, and responsibility in complex social systems. Such differences echo longstanding debates in sustainability education regarding instrumental versus transformative approaches to learning (Sterling, 2004; Wals and Jickling, 2002). Importantly, our findings suggest that these divergent understandings are not simply obstacles to be overcome but constitute distinct disciplinary affordances that shape what sustainability education can achieve in practice. Making these affordances visible, both to oneself and to others, emerged as a crucial step in enabling transdisciplinary dialogue and mutual learning.

The affordances of the transdisciplinary learning context included enhanced reflexivity, deeper critical engagement, and more effective professional learning than that typically achieved through interaction among colleagues within the same discipline. It is worthwhile mentioning here that, this multi-disciplinary group, not only encouraged active engagement with others' knowledge and perspectives in order to develop a shared understanding but also introduced uncertainty about one's own beliefs and practices leading thus to opportunities for learning and expanding understanding. Each participants' contribution unfolded as if before a mirror with other group members with diverse disciplinary backgrounds facilitating reflexivity since issues brought up were examined through constructive feedback, at times critically scrutinized, and often triggered meaningful discussions that generated valuable insights. The interaction within the PBL group participants helped in creating self-reflection for the individual, and they experienced transdisciplinary learning as efficient and rewarding.

TABLE 2 Perspectives on affordances and tensions.

	Affordances	Tensions
Participant 1 (economics and recycling)	New perspective for creating a more sustainable world; help in creating future agents for sustainability	Universities need to stop developing students to the old, consumerism-based society; new tools for this are needed in education
Participant 2 (communication sciences)	Deepen knowledge of the sustainability and broaden view on its interrelationships	Lack of communication aspects in sustainability; tensions between humanistic and exact sciences.
Participant 3 (mathematics)	Learning about the use of real-life cases in educations	Connection between subject area and sustainability
Participant 4 (regional studies)	Learning about the role of feelings in learning process	Global situation and how it may affect development of sustainability
Participant 5 (English language)	Integrating sustainability to internationalization activities; helping to create the people who make the future bright	Differing views about academic sustainability
Participant 6 (science education)	New networks, which help in developing HESD didactics and knowledge	HESD might prove to be too demanding if colleagues are not helping in advancing transdisciplinary approaches.
Participant 7 (pharmacology)	Pedagogical competence and broader sustainability view	The political aspects, which are prominent in the societal sustainability perspective, academic activism
Participant 8 (business administration)	Interdisciplinary reflections during the course	Discussions concerning the university's role on in advancing sustainability knowledge

5.3 Tensions in the learning process

The epistemic differences between disciplines are also manifested as tangible tensions, particularly at the beginning of the course. Several STEM participants described the experience as akin to "visiting another planet," struggling to relate both to the course material and to discussion formats that prioritized open-ended reflection and normative questioning. During this initial phase, participation was uneven: SHAPE participants were generally more positively vocal, supportive of the pedagogical approach, and comfortable engaging with the underlying assumptions of the course, while STEM participants often adopted more cautious or distanced positions. These early tensions can be understood as a form of disciplinary boundary work, where unfamiliar epistemic assumptions challenge established ways of knowing and teaching (Gieryn, 1999; Klein, 2010).

Over time, however, these tensions became increasingly productive. As the course progressed, and particularly through the collaborative auto-ethnographic work conducted after the course, participants began to explicitly articulate their disciplinary standpoints, assumptions, and constraints. This clarification helped create a shared language for discussion and reduced misunderstandings. Gradually, communication improved, and the different disciplinary "cultures" moved closer together. Notably, despite pronounced differences in political views, values, and teaching experiences, discussions did not become more polarized. Instead, repeated interactions, especially through synchronous online meetings, enabled participants to listen more carefully, acknowledge the validity of alternative perspectives, and incorporate elements of each other's arguments. While no overarching consensus was reached, the group developed more nuanced and interconnected lines of reasoning. This process aligns with research on boundary crossing and transdisciplinary learning, which emphasizes that learning across differences often results not in agreement but in increased mutual recognition and epistemic humility (Akkerman and Bakker, 2011; Star and Griesemer, 1989). The findings thus suggest that sustained dialogue in sustainability education can transform initial feelings of alienation into opportunities for deeper understanding and more robust pedagogical practice.

5.4 A teaching approach including affordances and tensions

Based on our experiences we see our process combining the different perspectives (affordances), which lead to tensions and this allowed us to learn from each others, which added deeper understanding on the issues, roles and challenges witin HEDS' teaching approaches. A new teaching approach mirroring our processes and findings, i.e., affordances and tensions in enhancing the HEDS learning experiences were discovered (see Figure 6) and interpreted as a future-oriented teaching approach established, catalyzing a further adapted and developed hybrid of Figures 1 and 2.

5.5 Limitations

In this study we have not included all types of disciplines. Still, there are several disciplines related to the STEM and SHAPE areas included in the study. Further, participants are representing only European countries, and the majority of participants included in the study came from the Nordic countries. The constellation of the study group depended on which teachers were participating in the HEDS group, and the participants could not affect this beforehand.

6 Conclusions, implications and future research avenues

At the beginning of this study, 8 teachers representing various disciplines participated in an online course, which taught them about similar aspects of sustainability (competencies, didactics and role of university). As can be seen from the results, there has been some variation concerning what aspects the teachers found especially interesting and how they in general approached teaching concerning sustainability. As the results do show, there are similarities, especially in expressing motivation towards teaching sustainability aspects. However, there are also some limitations on to what extent the

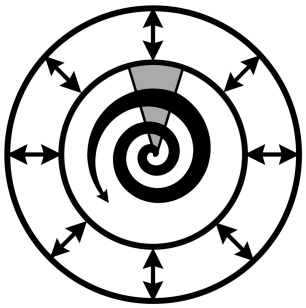

FIGURE 6
A "new" teaching approach mirroring our processes and findings, i.e., affordances and tensions in enhancing HEDS learning experiences discovered and interpreted as a possible teaching approach established [as a catalyst by, further adapted, and developed hybrid of the Figures 1 and 2].

different disciplines are willing and or able to go in their teaching. In societal and humanistic studies one may proceed to very practical and even political issues, whereas STEM disciplines struggle to include sustainability elements into their teaching, since they are essentially based on normative methodologies and on the very notion that the role of science is to prove things right or wrong, whereas other disciplines see that proving things right or wrong is not necessarily enough and that we need to figure out ways on how to give the students competencies to make the right decisions as future leaders and experts.

However, this analysis also shows why advancing HESD can be such a difficult task. Although the participants themselves have shown willingness to work in a multi-disciplinary group and even find like-minded people to share their educational concerns with, this is not necessarily the case in all disciplines. This means that instead of disciplinary approaches to higher education for sustainable development (HESD), these approaches may be more personal, which may diminish the effectiveness of advancing sustainability in higher education. For example, if some key disciplines do feel that sustainability does not affect them, then one aspect of looking at future solutions might be lost. Therefore, it would be beneficial to understand these disciplinary differences, but also the differences between different universities and individuals.

It has been shown that different perspectives have been a rewarding experience for the participants. Widening the own mindset will also take you out of the comfort zone and by doing this "risk" to learn something new and valuable. There are tensions between different disciplines but also affordances.

The findings of this study with digital meetings in an interprofessional PBL group revealed advanced levels of participants' commitment. Influencing factors for the group interaction were (Clarke et al., 2007): (1) group diversity in terms of ethnicity and experience and the alignment of demographic differences with differences in professions; (2) the approach taken by individuals in the role of facilitating and chairing in pairs and the expectations of the group participants about these roles; (3) the commitment of individuals in the topics as group task; (4) participants' skills and confidence in listening and sharing information with the group.

The study involved reflecting, finding, sharing, and discussing information within a short time frame. Our findings confirmed the importance of promoting respect for diversity, knowledge of group dynamics, knowledge sharing, sensitive communication and reflection on experience and practice within interprofessional learning initiatives, as identified in the interprofessional capability framework (Svensson et al., 2007; Walsh et al., 2005). Interprofessional group facilitation is a considerable challenge, which is highlighted also by Clarke et al. (2007). Encouraging activity and communication across professions, ethnicity, disciplines, and reducing isolation of individual HEDS participants, could be demanding in the support of participation and effective group functioning. By enabling informants to analyse the workings of the PBL group and to reflect upon their individual contribution, ensure that their learning has a foundation in practice.

Overall, the participants were positive about their experience of the digital interprofessional problem-based learning group and reported increased awareness of the need for, and skills associated with, interprofessional learning and working (cf. Clarke et al., 2007).

Implications for education didactics towards sustainability include considering possible affordances and tensions in the learning process. It is also of importance to include disciplinary variations in the learning, not the least related to both the STEM and SHAPE areas. In addition, to encourage activity and communication across professions, ethnicity, and disciplines in the learning process might help some tensions to transform into affordances. This could be seen as an opportunity for university-wide courses, where students from different disciplines would engage in sustainability aspects. The disciplinary mix might enhance their understanding of sustainability issues and would also offer an opportunity to learn firsthand, why some practitioners might not see sustainability issues in a similar manner. This might also enhance the way how future decision-makers may approach sustainability as a topic, since it means different things for people with different personal and professional backgrounds. It could also help in shaping university-focused views on sustainability, which could help in internal development discussions on how the local university community approaches sustainability challenges.

Indeed, future research would benefit from continuing the understanding of affordances and tensions in the learning process focusing on education didactics towards sustainability. From this lesson the authors are themselves most grateful.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

BN: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Data curation, Supervision, Validation, Writing – review & editing. PU: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing – original draft, Supervision, Writing – review & editing. AM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Supervision, Writing – review & editing. AV: Writing – original draft, Writing – review & editing. AD: Writing – original draft. AM-G: Writing – original draft. AL: Writing – original draft. HS: Conceptualization, Data curation, Formal analysis, Validation,

Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

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Supplementary material

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