Students between science and society: why students' learning experiences in transformative spaces are vital to higher education institutions

Lilian Julia Trechsel, Clara Léonie Diebold and
Anne Barbara Zimmermann
*Centre for Development and Environment (CDE), University of Bern,
Bern, Switzerland, and*

Manuel Fischer
Business School, Bern University of Applied Sciences, Zollikofen, Switzerland

Abstract

Purpose – This study aims to explore how the boundary between science and society can be addressed to support the transformation of higher education towards sustainable development (HESD) in the sense of the whole institution approach. It analyses students' learning experiences in self-led sustainability projects conducted outside formal curricula to highlight their potential contribution to HESD. The students' projects are conceived as learning spaces in "sustainability-oriented ecologies of learning" (Wals, 2020) in which five learning dimensions can be examined.

Design/methodology/approach – Using an iterative, grounded-theory-inspired qualitative approach and sensitising concepts, 13 in-depth semi-structured interviews were conducted exploring students' learning experiences. Interviews were categorised in MAXQDA and analysed against a literature review.

Findings – Results revealed that students' experiences of non-formal learning in self-led projects triggered deep learning and change agency. Trust, social cohesion, empowerment and self-efficacy were both results and conditions of learning. Students' learnings are classified according to higher education institutions' (HEIs) sustainability agendas, providing systematised insights for HEIs regarding their accommodative, reformative or transformative (Sterling, 2021) path to sustainable development.

Originality/value – The education for sustainable development (ESD) debate focuses mainly on ESD competences in formal settings. Few studies explore students' learnings where formal and non-formal learning meet. This article investigates a space where students interact with different actors from society while remaining rooted in their HEIs. When acting as "change agents" in this hybrid context, students can also become "boundary agents" helping their HEIs move the sustainability agenda forward towards a whole institution approach. Learning from students' learnings is thus proposed as a lever for transformation.

1. Introduction

What role do students play in higher education institutions (HEIs)? Are they and *should* they only be learners of predefined knowledge and skills that they will reproduce or use in future jobs? Or does society need students who are more agile, self-reflective, critical, responsive to societal reality and willing to act? Moreover, can HEIs be changed by taking students seriously as stakeholders who contribute to organisational change? In this paper, we argue that this is not only possible but necessary, providing evidence from a qualitative study on different dimensions of student learning that can support this endeavour. We conclude by sketching how HEIs as *learning* institutions can be inspired by students who engage in sustainability projects involving both the academic world and society at large.

Given the urgency of current challenges worldwide, HEIs are increasingly committing to sustainable development (SD) in their mission statements. However, they often conceive of SD sectorally, in a mode that Sterling (2021) calls mere "accommodation". While HEIs can contribute to the Sustainable Development Goals in this manner, they would likely be more effective if they adopted a "reform" mode, or even had the ambition of taking a "transformation" path (Sterling, 2021). To this purpose, they would need to adopt an SD-oriented "whole institution approach" (Wals, 2020; Sterling, 2021). In so doing, HEIs would ideally stop viewing students as mere recipients of knowledge and skills (Tilbury, 2016; Leal Filho *et al.*, 2018), and instead view them as stakeholders capable of helping to transform their institutions of learning and making meaningful contributions to SD (Winter *et al.*, 2015). The need for this type of broader understanding of education and learning is clearly articulated by the Berlin Declaration on Education for Sustainable Development (ESD) (UNESCO, 2021). Adopted on 19 May 2021, the Berlin Declaration calls for ESD, transformative learning, and a whole institution approach – defined by Rieckmann (2018) as "involv[ing] rethinking the curriculum, campus operations, organizational culture, student participation, leadership and management, community relationships and research".

Overall, HEIs need to expand their understanding of learning – both in terms of how they understand their educational mission and how they conceive of *who* should be the learners. *Firstly*, students need to acquire more than just (disciplinary) knowledge and skills – they also need to engage critically with societal attitudes, human values and the need for action (Hay *et al.*, 2019; Balakrishnan *et al.*, 2019). *Secondly*, HEIs must recognise that learning is not exclusive to the classroom and similar formal settings (Wals *et al.*, 2017), and that students are not the only learners, nor do they learn solely as individuals. Indeed – *thirdly* – opportunities for non-formal and joint learning are crucial for everyone involved in HEIs and should be fostered as a matter of institutional culture; Sterling and Maxey (2013) refer to this as creating a "culture of critical commitment". If HEIs fail to foster cultures of continuous learning, learning together, and rethinking institution-wide mindsets, they run the risk of remaining frozen in existing structures and values, unable to contribute to SD effectively (Macintyre *et al.*, 2020).

This highlights the rationale underpinning whole institution approaches to ESD, which emphasise awareness of sustainability challenges and the need for critical thinking, awareness of values, joint and lifelong learning for change and empowerment for sustainability agency in everyday contexts (Wals and Benavot, 2017). To characterise the context that emerges out of a whole institution approach, Wals (2020) has proposed the concept of "sustainability-oriented ecologies of learning". These ecologies enable learning of a holistic and interconnected nature, where different actors collaborate. In such ecologies of learning, there must be opportunities for transformation of people's mindsets, in settings that include diverse stakeholders – in addition to students – and provide learners with space for reflection and experimentation as well as for caring, taking action and developing change agency. "These ecologies of learning are nested in a wider community and often blur the boundaries between science and society, school/university and community, local and global, research and practise [. . .]" (Wals, 2020, p. 65). One important feature of such ecologies of learning is that distinctions between formal, non-formal and informal learning lose their saliency. In addition, Wals (2020) recommends focussing on five different dimensions of learning (*learning to know, to do, to care, to be and to transform*) that are highly connected, depend on different learning mechanisms and contribute to very different outcomes and processes. Spaces for transformation are developed in and through these sustainability-oriented ecologies of learning, in which students and other members of HEIs can challenge prevailing attitudes, experiment with new ways of thinking, experience disruption, co-create new ideas for change, as well as develop change agency (Drupp *et al.*, 2012).

A number of recent studies have explored how teaching and learning formats enable transformative moments in formal curricula and potentially support the development of change agency among participants (Rodríguez Aboytes and Barth, 2020). However, few studies have analysed the learning experiences of students in HEI-associated non-formal settings (Wals and Benavot, 2017; Rodríguez Aboytes and Barth, 2020) that incorporate societal actors and aim to contribute to SD. Exploring students' learning experiences can help to identify whether and how students develop change agency based on their learnings in non-formal HEI contexts, as well as how they can become "boundary agents" (McNie *et al.*, 2008) between science and society, thus contributing to implementing a whole institution approach.

We address this research gap by examining the learning experiences of students who launched initiatives at HEIs and explored spaces for sustainability mainly beyond their institutions' walls, i.e. in wider society. In this way, they experimented with learning and change agency both in their HEI and in society. Their initiatives were supported by the Swiss U Change programme (2017−2020), designed to enable students at Swiss HEIs to create action-learning spaces for various SD and ESD experiments, e.g. all-gender restrooms, ranking of smartphones and mapping of sustainable dietary guidelines. As initiatives occurred outside formal curricula, U Change projects present ideal case studies to explore students' learning for SD experiences in non-formal settings and make it possible to better understand what happens in "sustainability-oriented ecologies of learning". For this, we examined such projects using the following research questions:

RQ1. What *transformative spaces* did students use and shape?

RQ2. *How and what did students learn* through their initiatives and projects?

RQ3. How can student-led SD and ESD projects *foster transformation in their HEIs*?

Importantly, what we did not aim to do was to evaluate the U Change programme; instead, we focused on what learning experiences are possible in a non-formal HE context and whether they foster change agency. Guided by the overall concept of "sustainability-oriented ecologies of learning" (Wals, 2020), we sought to answer our *RQs* by conducting qualitative analysis of interviews with student project leaders who were awarded U Change project money. To capture the specificities of associated sustainability-oriented learning processes, we considered the non-formal learning setting of the project as an "ecology of learning" and structured our analysis according to the five dimensions of learning proposed by Wals (2020). Indeed, these five learning dimensions explicitly address the call for the holistic understanding of learning proposed by UNESCO (2021). Lastly, we reflected on lessons regarding students' potential to be boundary agents and change agents *vis-à-vis* three different types of HEIs: "accommodative", "reformative" or "transformative", in line with Sterling's (2021) differentiation of HEIs by how they engage with sustainability.

2. Literature review

The three *RQs* presented above emerged from and were refined by two rounds of literature review: one was conducted prior to the interviews and one was carried out after the analysis of the data. Our overall aim was to explore what learning environments support students' learning for SD as well as their HEI's ambition to contribute to SD.

2.1 The role of learning in higher education institutions: reformative or transformative?
Interest in what forms of pedagogy and curricula can foster SD competences in students has generated a rich literature featuring diverse pedagogical models. Shephard *et al.* (2018) have sought to unravel the complexity of resulting ESD discourses. Their hermeneutic inquiry reveals that the terms "competences" and "capabilities" are often marred by misunderstandings, especially across languages and pedagogical cultures. Their conclusion is:

> ESD does need to agree [on] terms that adequately describe educational processes designed to change *what learners will be willing to do or to be*, as different from processes designed to change *what learners know or what learners can do, if they choose to* (Shephard *et al.*, 2018, p. 13, our italics).

This fundamental distinction is arguably the line that can be drawn between HEIs that aim to *transform* themselves and those that seek only to *reform* themselves (Sterling, 2021). While the former are likely to include formats for transformative learning in their curricula (Rodríguez Aboytes and Barth, 2020) and institutional practices, the latter are likely to opt instead for narrower understandings of teaching and learning focused on acquisition of knowledge, skills and critical thinking, but wary of tackling human values and the emotions related to them or the need for action and transformation.

The aim of learning in the *reformative model* is that students move towards interdisciplinarity to improve their systemic understanding of sustainability and real-world problems (Ashby and Exter, 2019). The aim of learning in the *transformative model* is that students (and other actors) advance towards hands-on change agency for SD (Briggs *et al.*, 2019; Trechsel *et al.*, 2021). Whatever the striven-for degree of change – reformative or transformative – ESD experts agree that HEIs must support creation of "safe spaces" to facilitate disruptive learning concerning SD challenges and inspire students to step outside their comfort zone. By contrast, the *accommodation model* (Sterling, 2021) refers to learning *about* SD, which does not require creation of safe spaces for disruptive learning.

2.2 What do safe spaces enable?

Many ESD scholars favour the transformative model, including Wals (2020), who advocates blended spaces where disruption and discomfort are triggered, enabling boundary-spanning learning to occur. He also emphasises that social cohesion, trust and respect are needed as a basis for interaction in such spaces. In addition, students benefit from a sense of freedom and empowerment in safe spaces (Haber-Curran and Tillapaugh, 2014). Further, Briggs *et al.* (2019) and Barth and Michelsen (2013) add that providing a safe space in which students can fail is essential, while Förster *et al.* (2019) and Winter *et al.* (2015) emphasise that a change of mindset (and ultimately behaviour) is only possible if participants' emotions and intuitive selves are given space in the learning process.

Another crucial aspect of learning in such spaces is critical self-reflection (Haber-Curran and Tillapaugh, 2014; Singer-Brodowski, 2016; Drupp *et al.*, 2012). Singer-Brodowski (2016) highlights self-organised, problem-based learning and shows how self-determination in self-organised learning can increase students' intrinsic motivation and foster a deeper sense of ownership. Focusing on student initiatives for SD as learning spaces, Drupp *et al.* (2012) emphasise how students experience self-empowerment by acquiring knowledge in a self-reflective way; moreover, through participation and cooperation, they experience self-efficacy, self-learning and self-organisation. A recent study of student interventions concerning Urban Greening Processes (Stobbelaar, 2020) confirmed the self-organising, empowered, networked and mutual learning paths forged by students in their campus initiatives and underscored particular benefits, stating:

> [students having] time, thinking out of the box and a certain innocence, as they (unconsciously) used their outsider position to ask questions that more involved people cannot ask. Students can bring excitement, action and energy. Their mere presence can make a difference and start a process of change (p. 12).

Interestingly, this proactive student attitude has also been confirmed from a historical perspective by Lange (2019), who observed that students have always been more than passive learners of curricula regardless of the change model that guides an HEI. Indeed, in past centuries, students have also been actors engaged in questioning and trying to transform society and their HEIs, sometimes against the grain of institutional and societal structures, and other times as institutional allies.

2.3 Students as "change agents" and "boundary agents" between science and society

Building bridges between science and society is part of HEIs' third mission (Geier, 2018) and thus relevant to integrating sustainability in HEIs. The question is: how can this science–society interface be shaped to serve sustainability, and what role can students play? ESD scholars have emphasised that students can become "change agents". This role has been defined as one in which "the researcher seeks to motivate and empower participants, for example, to address local (sustainability) challenges, and networks with stakeholders outside the protected space" (Wittmayer and Schäpke, 2014). This definition certainly applies to students who initiate and lead HEI-supported societal projects. Such students can also help address various boundaries between the worlds of science and society, enabling joint learning and decision-making for action (Schröder *et al.*, 2020; Drupp *et al.*, 2012). In other words, change agency is a necessary condition for moving towards sustainable development. To be effective, change agency requires being able to perceive different perspectives and meaning frames (Lotz-Sisitka, 2018). As we argue below, this can be achieved – among others – through "boundary agency", which helps increase communication between science and society.

The position at the boundary between science and society has often been explored in connection with science and policy. Guston (2001) highlighted the ability of "boundary organizations" to use "boundary objects" (Star and Griesemer, 1989) and link (scientific) knowledge and action (in society) in a "simultaneous production of knowledge and social order" (Guston, 2001, p. 401). In sustainability research, the term "boundary agent" has also emerged. According to observers, experience shows that "boundary agents, individuals who may work for or with the boundary organization [. . .,] play a central role in creating and sustaining relationships, building trust, communicating information needs and concerns, and bridging gaps between various stakeholder groups" (McNie *et al.*, 2008, p. 2). Further, the success of such agency depends on how deeply given actors are embedded in the communities they are engaged in. This requires trusting relationships, which can only be developed in a boundary-spanning "safe space" where trust is built because the "boundary agent" is a member of both worlds (McNie *et al.*, 2008). Here, the change agency of boundary agents is arguably heightened by the *credibility* and *legitimacy* afforded them for belonging to each world; their agency also acquires *salience* due to the immediacy of the sustainability concerns and the contexts addressed. In this way, all three conditions cited by Cash *et al.* (2003) as necessary for making knowledge for SD effective – i.e. *credibility*, *legitimacy* and *salience* – are available and can lead to action, often initiated by change agents.

2.4 Ecologies of learning as key environments providing holistic learning spaces

In HEIs that offer "sustainability-oriented ecologies of learning", agency, diversity and disruption, boundary crossing, and ethics and values act as "transition levers" (Wals, 2020). Fostering change agency requires a more holistic understanding of education, in which non-formal and informal learning can occur within the formal context (Wals and Benavot, 2017; Lotz-Sisitka *et al.*, 2015). Holistic learning can be facilitated by allowing "diversity and dissonance, in order to deepen the learning [and] recognize multiple ways of knowing and being in the world" (Macintyre *et al.*, 2020, p. 19). In Wals' (2020) view, ecologies of learning offer "blended learning space[s]" – "an organic system that allows those who are actively engaged *in* and *with* the system to learn in different ways" (p. 63) and in different learning dimensions. According to Wals:

> [I]n line with systems-thinking thought, the whole is [considered] more than the sum of its parts. The "learning" refers to the reflexive element. [. . .] A sustainability-oriented ecology of learning essentially comprises a vital coalition of multiple stakeholders engaged in addressing a common challenge and/or realizing a common vision [. . .] (pp. 63–64).

An HEI with a whole institution approach can help foster such spaces, with students working with others not only to acquire knowledge, but also to "do", to "be" (Shephard *et al.*, 2018), to "care" and to "transform" (Wals, 2020).

3. Methodology

3.1 Context

In the present study, we focused on students' learning experiences in projects they successfully submitted to U Change, a Swiss national programme funded by the State Secretariat for Education, Research and Innovation (SERI). The aim of this four-year programme (2017–2020) was to provide a platform for SD that would enable students to work across disciplinary boundaries and develop connections with societal actors, with a view to learning and working for SD in self-initiated projects. The programme enabled students to practise critical reflection, develop a systems perspective, contribute concrete and practice-oriented inputs, establish contacts with future employers and learn to plan and

implement a project while developing business skills (Swissuniversities, 2016). Student project proposals had to obtain a 50% financial commitment from their home university before submission; if successful, they received the other 50% from the U Change programme and launched their project.

3.2 Sampling, data collection and data analysis

In June 2020, the U Change programme coordinator contacted all 42 U Change student project leaders by email to ask them whether they agreed to share their project reports with the authors of the present study. Project leaders from 23 projects agreed to do this. To deepen our understanding of the project leaders' learning experiences, we asked the 23 project leaders whether they would also agree to an in-depth interview; 13 students from 12 projects, aged 24–40 (average: 29.5 years, representative of the overall age distribution) agreed to be interviewed in January and February 2021. Interviewees were either still enrolled or had recently graduated. Interviews lasted 31–77 min (average: 48 min); 11 were conducted in German and two in English. Interviewees were guaranteed confidentiality and asked to sign a consent declaration. Other ethical issues were addressed in thorough discussion of the research design with a group of experts.

The study researched student projects that had received U Change funding and had been completed. The data set therefore did not provide information on the learning experiences of students whose project proposals had failed, as these contacts were not available, and it was not clear whether these students had gone ahead with their project ideas although they had not received funding. The data set thus includes the personal experience of 13 successful proposal submitters; it was not possible to assess whether findings regarding learning processes might be dissimilar for unsuccessful submitters. Nonetheless, two interviewees reported that they failed with their first proposal but were successful with their second application.

Our overall qualitative approach was inspired by grounded theory (Strauss and Corbin, 1996), which enables collection and analysis of data in a structured and simultaneously open, self-reflective and iterative way, to deepen understanding of a phenomenon. The interview guide for the in-depth semi-structured interviews contained five open-ended questions, allowing interviewees to speak freely about their personal experiences (Kruse, 2015). A few additional sub-questions were available, if needed, to go into greater depth. To avoid bias, interviewees were only sent a brief description of the purpose and focus of the interviews in advance. In the interviews, students were first asked what they were able to initiate through their project and what results they were particularly pleased with. Question 2 inquired about any important experiences that were enabled in the project. The third question investigated the difference between learning experiences garnered in the project and learning experiences obtained in formal university courses. Afterwards, interviewees were asked to describe any situation in which their learnings were particularly rich. Lastly, they were asked to describe their learnings with partners.

All interviews were conducted online due to COVID-19. Transcription of the recorded interviews was done verbatim with voice recognition software (FX4), followed by careful corrections. Our initial test interview was included in the final data set, as it was complete and satisfactory.

We used sensitising concepts, i.e. "interpretive devices and [. . .] a starting point for a qualitative study" (Bowen, 2006), to initiate the process of analysis (Kruse, 2015). The three sensitising concepts – transformative spaces, learning dimensions, transformation of HEIs – were defined based on the main elements derived from our three initial research questions, enriched by the five learning dimensions (Wals, 2020) of ecologies of learning: *learning to*

know, to do, to care, to be and *to transform*. For the inductive analysis of interview data using open coding (Strauss and Corbin, 1996), 25 main categories were derived from the aggregation of a very broad spectrum of 88 categories drafted independently by three authors, so as to avoid a one-sided perspective (Kruse, 2015). These 25 main categories were then subsumed under the original three sensitising concepts (selective coding process). Interviews were categorised using the program MAXQDA. For the analysis, coded segments were exported to Excel and then analysed more in depth. Numerous quotes to illustrate the main findings were selected in a first round by the first author and submitted to two other authors, who chose the most relevant ones for each topic of analysis, thus reducing the corpus by two thirds.

The conceptual argumentation presented above in our introduction and literature review served as the analytical frame in which our three research questions were set and interview data were analysed after they had been coded (Strauss and Corbin, 1996), with the overall aim of addressing the question of what role students can play in their HEIs, considering their learning experiences and the diversity of HEIs' SD strategies. The results are presented according to the three *RQs* and corresponding sensitising concepts in three consecutive sections (4.1–4.3).

4. Results and discussion

4.1 Creative and safe spaces for transformation

In the interviews, students highlighted the collaboration and networks that they built in their respective HEIs – between different disciplines (interdisciplinarity) and with fellow actors such as sustainability managers. They also emphasised the networks and collaboration they developed beyond the walls of their HEIs when working with societal actors. Many encountered open doors when interacting with these actors but found it challenging to provide them with suitably packaged scientific insights. They experienced acting as "bridge builders" or "catalysts", occupying a boundary-spanning position, and described this as a way of overcoming barriers between science and society:

> It's not just "ivory tower" science, but something concrete and real. It doesn't increase the divide between science and society, but instead tries to repair certain rifts in some way. (Respondent 9)

Students were enthusiastic about motivating other students and moving together in the same direction. They enjoyed exchanging with students from other HEIs and sharing their experiences dealing with "stubborn structures". They also appreciated their project-related role at their respective HEI, which enabled them to "jump hierarchies" and gain an audience with university rectors or presidents:

> To implement certain things, there's an initial spark needed that students can provide, since we can be a bit more disruptive in our demands and more disruptive about existing structures; many others can't bypass certain hierarchies and remain more or less blocked [. . .] We [simply] went to the office, knocked on the door, and said we'd like a meeting. (Respondent 8)

Interviewees described how their student projects enabled them to learn in a more dynamic, creative way at various levels, and to engage in a continuous learning process. This also gave them room to let go of scientific knowledge acquisition habits and to experience learning differently. They highlighted how a new, creative, safe space for learning opened up, not only for themselves, but also for others – a space they had never occupied before, in which more diverse groups of people belonged. They described it as a valuable space for learning and a more comfortable educational space for "our generation":

It's a place where you can express yourself, in a safe space and surrounded by people who encourage you to keep going [. . .]. In many places, there's simply no such space where you can express yourself that way and receive a genuinely well-intentioned suggestion in return, rather than just criticism. (Respondent 8)

Interviews revealed that recognition from others is crucial. In the formal teaching environment, some students felt they were assessed as "either right or wrong"; if they were seen as wrong, they felt disqualified. The fear of being judged as a non-achiever was described as crippling and isolating. By contrast, the student projects provided students with a sense of security, backing and legitimacy with regard to the topics/activities they engaged in. In one case, the legitimacy came because the student was perceived to be neutral in a conflictual setting. The projects also provided them with institutional legitimacy and the opportunity to assume a leadership role and leverage impacts. Interestingly, in the context of COVID-19 restrictions, interviewees repeatedly mentioned that they preferred and missed the "physical space", including face-to-face meetings, and found online communication difficult.

Overall, students emphasised the importance of building networks and collaboration beyond their HEIs. They described the bridge created between their home institution and local community members as a flourishing environment (Schröder *et al.*, 2020). Students created new spaces with their projects, sometimes adopting unconventional approaches and exhibiting a certain innocence (Stobbelaar, 2020). They profited from a safe and creative space where "out of the box" thinking and doing were allowed (Briggs *et al.*, 2019) and where diversity and mutual recognition empowered students.

4.2 Understanding students' learning experiences

4.2.1 Learning to know. Project leaders developed soft skills, which helped them to organise, plan and manage their activities. Enhancing their communication and management skills and handling finances were listed as key learnings. Students emphasised the need and the importance of such skills in the labour market. The knowledge they gained was useful not only for their university life, but also for life in general:

These are things that not only help in the daily work at the university, but also help you to stand on your own two feet in life. And they also help to organize life. (Respondent 4)

Students emphasised that, in their usual studies, they typically learned much more about "the what" than "the how" of particular fields. The hands-on learning involved in their student projects was highly appreciated. For many, an important step was writing the project proposal – some failed in the first round and this pushed them to do it again and better.

Students highlighted that they acquired knowledge in multiple ways (Macintyre *et al.*, 2018). They experienced forms of failure that did not disqualify them, e.g. because they had a second chance to hand in proposals. This culture of advancing through "failure" has been observed as an enabling factor by Briggs *et al.* (2019) and Barth and Michelsen (2013).

4.2.2 Learning to do. One core experience students had in their projects was that of testing out new things in a trial-and-error manner. They learnt to do things themselves in real-world contexts, often finding that the reality of matters was much different from what they had learnt in "theory". They spoke of the importance of the unconventional paths they took in their projects, the value of having the chance to make mistakes and how they learnt from this. They explicitly spoke about the relevance of acknowledging errors and how it was useful to make mistakes specifically because the resulting lessons were so valuable:

In certain phases, we had to fall on our face yet again in order to realize that the original idea maybe wasn't the smartest one. (Respondent 9)

Good communication was acknowledged to be an important skill in settings where "learning by doing" was paramount. Interviewees emphasised the importance of taking time to reflect. They reflected on their own actions by listening to each other and getting to know different perspectives, with the goal of working as a team to find out why some things worked and others did not:

> And then you just begin to reflect and you ask yourself: "Why didn't it work?". In the conversation afterwards, when you discuss things, you realize maybe that there are very different perspectives. (Respondent 5)

Students strove to overcome their own limitations and reach the same wavelength as others. They succeeded in going beyond their original disciplinary thinking, identifying links between complex topics. They developed new mental maps and learned to think more holistically. They spoke about the flexibility they developed to grapple with uncertainties.

Students also emphasised the importance of developing the ability to present in front of audiences of experts:

> You learn to stand up in front of people and to talk to people you see as authorities, and you gain the confidence to express yourself and to present yourself in front of others. (Respondent 4)

In this sense, students' learning experiences were similar to what Stobbelaar (2020) found when he explored how students organise themselves and share information. A major part of the student projects entailed learning to self-organise. Students also appreciated "learning by doing" (Poland, 2021). Such self-learning facilitates deep learning processes and challenges students emotionally (Singer-Brodowski, 2016).

4.2.3 Learning to care. Interviewees also pointed out how important the emotions were that they experienced in their project teams, including sharing similar feelings, the same mindset and passion and the desire to head in the same direction to reach a goal. Students spoke about the power they felt knowing that the team stood behind them. Many interviewees mentioned the deep learning experience they had when laughing or crying together and sharing great moments: this seems to have made them appreciate and support each other as a team – an emotional experience that continued to resonate well beyond the end of the project:

> The wonderful moments we shared together, they warm your heart, there's no other way to put it. (Respondent 9)

Getting to know each other's perspectives seems to have enabled students to feel empathy and respect and to encourage one another to go on. Many team members became friends. Apparently, they learnt from each other by giving and receiving trust, establishing emotional ties and allowing everyone to speak about failures, fears, and obstacles:

> If we hadn't become friends, if we hadn't cultivated this team spirit, it would have been difficult to say: "I have failed". (Respondent 8)

Interviewees' emphasis on caring and sharing values highlights how individual learning is strongly connected to social processes. Wals (2020) highlights that social cohesion makes it possible to build social ties in heterogeneous groups and enables questioning of mindsets.

4.2.4 Learning to be. Observations made by Haber-Curran and Tillapaugh (2014, esp. Figure 1, p. 16) underline the dependency on and fluid relationship between the experience of challenging mental models, building trust, finding freedom and empowerment, developing commitment and reframing learning and the self. Placing the "self" in focus, students experienced personal development and self-awareness as a challenging, enriching process:

they realised their limitations, resolved to work on them and sometimes experienced themselves as a new person. Many of the interviewees increased their sense of self-efficacy, giving them the confidence to feel good in their own skin or individual personality:

> I was able to create an environment in which I feel comfortable in my own identity. (Respondent 8)

Often, learning experiences that led to self-awareness were linked to positive emotions generated by the team experience. Joy came from pulling in the same direction, working with one's heart and soul and realising that it is possible to change things. Such social ties seem to foster awareness, learning and action (Lange, 2019). Students emphasised that taking action, taking risks and showing perseverance opened their eyes to opportunities for success:

> The progression of the project demonstrated that "constant dripping wears away the stone". And if you really keep at something, it will eventually lead somewhere. (Respondent 9)

Nevertheless, the learning situation sometimes triggered negative emotions. Some students felt challenged by difficult interpersonal relationships, loss or lack of teamwork, dealing with individuals with dominant egos and moments of deep frustration or harsh criticism. Handling frustrating moments seems to have made students conscious of the importance of emotional learning, which requires time and reflection:

> And then you're frustrated, above all, because the house of cards you built, so to speak, comes tumbling down [. . .] and [it] takes time to process these emotions. (Respondent 5)

4.2.5 Learning to transform. Facing emotional challenges can be an important learning edge (Förster *et al.*, 2019), enabling students to "learn to transform" (Wals, 2020). Students realised that being in an uncertain life phase opened them to new ideas. They felt very flexible in their way of thinking and receptive to unplanned knowledge and experiences. They described their state as "free-floating" and underlined their strong desire to be disruptive and engage on behalf of SD, other students and necessary changes. It seems that they felt that being a student could lead them through rites of passage resulting in new orientations, lifestyles and thinking:

> Because, as an adult, you can get stuck in compartmentalized thinking, day-to-day thinking, routine thinking. But as a student it's different [. . .]. We have so many different perspectives that we bring with us, and if you really stimulate [our imagination] and encourage us to think for ourselves, there's huge potential there for numerous ideas. (Respondent 10)

Interviewees emphasised the different perspectives they acquired by sharing experiences. They felt that what they do provides fertile ground for different kinds of learning and change, as well as motivation for new initiatives:

> It's a different kind of learning because you don't do it simply to learn, but rather because you're motivated to change something. (Respondent 4)

They also experienced the power to motivate other students and societal actors. Joint learning is highly valuable here (Schröder *et al.*, 2020). Collaboration between students and local stakeholders can empower participants and produce change agency (Drupp *et al.*, 2012).

4.3 Transformation of higher education institutions and beyond

The empirical data reveal major potential for change in and outside HEIs. Students described how they successfully "sowed the first seed", provided an "initial spark" or "set

the ball rolling". Many felt the need to sensitise others and act as bridgebuilders between their HEIs and various external domains (e.g. work, community, city, country):

> After all, students are just at university for a certain amount of time and take [their experience] with them also in their learning following university – so, longer term, I might also imagine an impact there. (Respondent 13)

Students experienced significant support from university staff, especially their supervisors, and found allies within HEIs. Financial support from the programme and their HEI also played a fundamental role, not least in legitimating their project. They received recognition for their work from external partners and seem to have felt empowered as so-called "boundary agents" (McNie *et al.*, 2008).

However, while students' projects received basic funding, a large part of the work was done on a voluntary basis. This voluntary work was seen as a two-edged sword, raising disruptive questions (Wals, 2020) about the role of the wider economic system *vis-à-vis* SD goals. On the one hand, voluntary work was experienced as very fulfilling, a source of precious learnings and as providing an opportunity to demonstrate commitment. On the other, students reported that this voluntary work was only possible for those who were indirectly supported, e.g. by parents who helped them cover their living expenses. Some reported that it was difficult to find motivated colleagues to support their initiative, as their fellow students were too busy studying to join a project. Others mentioned that they did not feel recognised as equal partners because unpaid work was not valued the same as paid work, especially by external partners. Students also viewed the transition from voluntary work to work outside HEIs as difficult.

Importantly, the interviewees also realised that they acquired power through their initiatives: they found ways to put pressure on HEIs and influence their SD strategies:

> You can achieve a lot like this, because you have a lot of supporters within existing structures, some of whom cannot or aren't allowed to express things openly, but who are still very happy to join when they see such a movement coming together. (Respondent 8)

Students also expressed a desire for their HEIs to serve as SD role models. They hoped their initiatives would spill over and impact HEI structures. They argued that student initiatives bear great potential for HEI public outreach. Further, students emphasised the importance of building soft skills to make them ready for the labour market, benefitting from contacts for new job arrangements and exchanging and reflecting with actors from society, something they missed in the normal course of studies at HEIs. They emphasised that the time they spent in their HEI was short but that their learnings would last much longer.

5. Conclusions: learning from students' learnings: different pathways towards integration of sustainability in higher education institutions

Heeding the call to transform HEIs on behalf of the SD goals, our research sheds light on students' learning experiences where formal and non-formal learning meet. We analysed these experiences along the five learning dimensions Wals (2020) evokes in his model of "sustainability-oriented ecologies of learning". Our results show that student-led projects provide significant, diverse potential for deep learning, going beyond disciplinary, formal learning. Such learning is often transformative, individually and socially, both within HEIs and outside them, leading to change agency.

The study setting, supported by a Swiss sustainability programme for tertiary students, enabled students to enter a safe and transformative space to acquire new skills, self-reflect, experiment with crossing boundaries between clearly demarcated socio-professional

environments, co-design new practices based on SD knowledge and translate these practices into action. Students exploited these spaces for their learning experiences and also shaped them: some worked in sustainability projects as boundary agents, learning and acting in two worlds, providing crucial links between science and society. Such projects bear great potential for HEIs that want to strengthen their contributions to sustainability, no matter how ambitious these strategies are in terms of contributing to societal transformation. In Table 1, based on our empirical and theoretical results, we propose three learning environments through which students (and other actors) can support SD changes at their HEIs. We suggest that HEIs can foster one or more of these learning environments based on their level of sustainability ambition, in line with Sterling's (2021) distinction between:

- *accommodation*: HEI espouses third mission for "business as usual", adopts campus greening and education about sustainability in obvious disciplines;
- *reform*: HEI integrates SD at policy level in a sectoral way in campus, curricula and research activities; and
- *transformation*: HEI follows sustainability ethos that leads to fundamental redesign and iterative learning, as well as to a holistic approach (whole institution approach).

Level of HEI sustainability ambition (Sterling, 2021) and corresponding learning environment*:	Creates a safe space and/or spaces between science and society in which students learn by…
Accommodation: In an accommodative environment, HEIs can accomplish their third mission by enhancing students' options for…	… making their activities visible … conducting pioneering SD projects … being SD innovators … experiencing success … closing the society–science gap
Reform: In a reformative environment, HEIs with a sectoral SD policy approach can enhance students' options for…	… being self-reflective … doing, sharing, and searching … using dynamic, creative learning approaches … collaborating and building networks beyond HEIs … building professional skills for life (e.g. communication) … acting as multipliers by inspiring and motivating others … sowing seeds, having impacts … experiencing continuous learning … gaining recognition from others
Transformation: In a transformative environment (sustainability-oriented ecology of learning, Wals, 2020), HEIs can enhance students' and other learners' options for…	… widening the range of knowledge, skills, and perspectives … failing creatively … leaving their comfort zone … being empowered for action … facing emotions and dealing with disruptive moments … taking risks and acting based on transformative insights … increasing self-awareness and -efficacy … caring for, respecting, trusting, and doing things for others … being open to unplanned knowledge and unconventional paths … thinking and learning holistically … consciously acting as free-floaters, mediators, or catalysts … transcending hierarchies and developing reflective leadership skills … acquiring power to contribute to HEI's SD commitments … becoming aware of the problematic dichotomy between voluntary and paid work

Note: *The shades of grey indicate that "reform" can include "accommodation" strategies, and "transformation" can include both others
Source: Own data

Table 1.
Three learning environments arranged according to the degree of HEI sustainability ambition: the more transformative the ambition, the more transformative the learning will be that is made possible in the environment, and the more likely students will be able to contribute to that ambition via their learning experience

We agree with Sterling (2021) that many HEIs remain in the "accommodative" category, at best, while others even refuse to respond to urgent sustainability issues in their strategies (Sterling calls this the "no response" category). While national programmes like U Change increase the chances that HEIs can and will begin responding, it is also crucial to ensure that HEIs recognise the opportunities they can gain from students' learning paths. Our research shows the benefits of creating spaces that enable boundary crossing between formal and non-formal learning. Moreover, if learning is understood holistically, all stakeholders should have the chance to be learners, experience mindset changes and confront the challenges of societal transformation. We perceive transformative spaces as essential to enable students to shape their HEIs towards SD. But, such environments are only timidly emerging to date, and bolder action is needed. A first step can be to operationalise Table 1 in specific contexts, working with the relevant stakeholders in the specific HE sector (and beyond) who want to or could be involved in transforming higher education.

In addition to this practical suggestion, we recommend engaging in further research on learning in non-formal settings in the higher education sector. Few HEIs have engaged in implementing a whole institution approach where such learning is possible in a systematic way, and there is a need to explore what the impact of holistic learning is, not least of all by continuing research on students' (and other learners') learning experiences and on development of such essentials as boundary agency and change agency. At the same time, it would be important to develop, implement and assess quality assurance programmes that are designed specifically for a whole institution approach. Let us strive to fulfil the decades-old vision (Stephens *et al.*, 2008) that HEIs become change agents themselves, tackling the challenges of the future using a collaborative whole institution approach, facilitating sustainability-oriented ecologies of learning, and partnering with society in a transformative way in all three missions they currently have – research, education and third mission.

References

Ashby, I. and Exter, M. (2019), "Designing for interdisciplinarity in higher education: considerations for instructional designers", *TechTrends*, Vol. 63 No. 2, pp. 202-208.

Balakrishnan, B., Tochinai, F. and Kanemitsu, H. (2019), "Perceptions and attitudes towards sustainable development among Malaysian undergraduates", *International Journal of Higher Education*, Vol. 9 No. 1, pp. 44-51.

Barth, M. and Michelsen, G. (2013), "Learning for change: an educational contribution to sustainability science", *Sustainability Science*, Vol. 8 No. 1, pp. 103-119.

Bowen, G. (2006), "Grounded theory and sensitizing concepts", *International Journal of Qualitative Methods*, Vol. 5 No. 3, pp. 12-23.

Briggs, S.J., Robinson, Z.P., Hadley, R.L. and Laycock Pedersen, R. (2019), "The importance of university, students and students' union partnerships in student-led projects", *International Journal of Sustainability in Higher Education*, Vol. 20 No. 8, pp. 1409-1427.

Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jäger, J. and Mitchell, R.B. (2003), "Knowledge systems for sustainable development", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 100 No. 14, pp. 8086-8091.

Drupp, M.A., Esguerra, A., Keul, L., Beer, D.L., Meisch, S. and Roosen-runge, F. (2012), "Change from below – student initiatives for universities in sustainable development", in Filho, W. (Ed.), *Sustainable Development at Universities: New Horizons*, Peter Lang Scientific Publishers, Frankfurt.

Förster, R., Zimmermann, A.B. and Mader, C. (2019), "Transformative teaching in higher education for sustainable development: facing the challenges", *GAIA – Ecological perspectives for Science and Society*, Vol. 28, pp. 324-326.

Geier, I. (2018), "Active citizenship learning in higher education", *Zeitschrift Für Hochschulentwicklung*, Vol. 13, pp. 155-168.

Guston, D.H. (2001), "Boundary organizations in environmental policy and science: an introduction", *Science, Technology, and Human Values*, Vol. 26 No. 4, pp. 399-408.

Haber-Curran, P. and Tillapaugh, D.W. (2014), "Student-centered transformative learning in leadership education: an examination of the teaching and learning process", *Journal of Transformative Education*, Vol. 13 No. 1, pp. 65-84.

Hay, R., Eagle, L., Saleem Muhammad, A., Vandommele, L. and Li, S. (2019), "Student perceptions and trust of sustainability information", *International Journal of Sustainability in Higher Education*, Vol. 20 No. 4, pp. 726-746.

Kruse, J. (2015), *Qualitative Interviewforschung. Ein Integrativer Ansatz*, Beltz Verlag, Weinheim.

Lange, E.A. (2019), "Transformative learning for sustainability", in Leal Filho, W. (Ed.) *Encyclopedia of Sustainability in Higher Education*, Springer Nature, Cham.

Leal Filho, W., Raath, S., Lazzarini, B., Vargas, V.R., DE Souza, L., Anholon, R., Quelhas, O.L.G., Haddad, R., Klavins, M. and Orlovic, V.L. (2018), "The role of transformation in learning and education for sustainability", *Journal of Cleaner Production*, Vol. 199, pp. 286-295.

Lotz-Sisitka, H. (2018), "Think piece: pioneers as relational subjects? Probing relationality as phenomenon shaping collective learning and change agency", *Southern African Journal of Environmental Education*, Vol. 34, pp. 61-73.

Lotz-Sisitka, H., Wals, A.E.J., Kronlid, D. and Mcgarry, D. (2015), "Transformative, transgressive social learning: rethinking higher education pedagogy in times of systemic global dysfunction", *Current Opinion in Environmental Sustainability*, Vol. 16, pp. 73-80.

McNie, E.C., VAN Noordwijk, M., Clark, W.C., Dickson, N.M., Sakuntaladewi, N., Suyanto, Joshi, L., Leimona, B., Kurniatun, H. and Khususiyah, N. (2008), "Boundary organizations, objects, and agents: linking knowledge with action in agroforestry watersheds", Report of a Workshop held in Batu, Malang, East Java, Indonesia — 26–29 July 2007. CID Graduate Student and Research Fellow Working. Cambridge: ICRAF Working Paper No. 80, World Agroforestry Centre.

Macintyre, T., Lotz-Sisitka, H., Wals, A.E.J., Vogel, C. and Tassone, V. (2018), "Towards transformative social learning on the path to 1.5 degrees", *Current Opinion in Environmental Sustainability*, Vol. 31, pp. 80-87.

Macintyre, T., Chaves, M., Monroy, T., Zethelius, M.O., Villarreal, T., Tassone, V.C. and Wals, A.E.J. (2020), "Transgressing boundaries between community learning and higher education: levers and barriers", *Sustainability*, Vol. 12 No. 7, pp. 1-24.

Poland, B. (2021), "From classrooms to social movements", *GTI Forum Contribution*, Tellus Institute, Cambridge.

Rieckmann, M. (2018), "Learning to transform the world: key competencies in ESD", in Leicht, A., Heiss, J. and Byun, W.J. (Eds), *Issues and Trends in Education for Sustainable Development*, UNESCO, Paris, pp. 39-59.

Rodríguez Aboytes, J.G. and Barth, M. (2020), "Transformative learning in the field of sustainability: a systematic literature review (1999-2019)", *International Journal of Sustainability in Higher Education*, Vol. 21 No. 5, pp. 993-1013.

Schröder, L.-M.U., Wals, A.E.J. and VAN Koppen, C.S.A. (2020), "Analysing the state of student participation in two eco-schools using Engeström's second generation activity systems model", *Environmental Education Research*, Vol. 26 No. 8, pp. 1088-1111.

Shephard, K., Rieckmann, M. and Barth, M. (2018), "Seeking sustainability competence and capability in the ESD and HESD literature: an international philosophical hermeneutic analysis", *Environmental Education Research*, pp. 1-16.

Singer-Brodowski, M. (2016), "Students' competency development in the context of self-organised and project-oriented sustainability seminars: research at the interface between self-description and real-life action", in Barth, M., Michelsen, G., Rieckmann, M. and Thomas, I. (Eds), *Routledge Handbook of Higher Education for Sustainable Development*, Routledge, London.

Star, S.L. and Griesemer, J.R. (1989), "Institutional ecology, 'translations' and boundary objects: amateurs and professionals in Berkeley's museum of vertebrate zoology, 1907-39", *Social Studies of Science*, Vol. 19 No. 3, pp. 387-420.

Stephens, J.C., Hernandez, M.E., Román, M., Graham, A.C. and Scholz, R.W. (2008), "Higher education as a change agent for sustainability in different cultures and contexts", *International Journal of Sustainability in Higher Education*, Vol. 9 No. 3, pp. 317-338.

Sterling, S. (2021), "Educating for the future we want", *GTI Forum Opening Essay*, Tellus Institute, Cambridge.

Sterling, S. and Maxey, L. (2013), "The sustainable university: taking it forward", in Sterling, S., Maxey, L. and Luna, H. (Eds), *The Sustainable University: Progress and Prospects*, Earthscan (Routledge), Abingdon.

Stobbelaar, D.J. (2020), "Impact of student interventions on urban greening processes", *Sustainability*, Vol. 12 No. 13, pp. 1-19.

Strauss, A. and Corbin, J. (1996), *Grounded Theory: Grundlagen Qualitativer Sozialforschung*, Beltz Verlag, Weinheim.

Swissuniversities (2016), "Projektgebundene beiträge 2017-2020 nach HFKG projektantrag, [pdf], schweizerische hochschulkonferenz, Bern", available at: https://api.swiss-academies.ch/site/assets/files/33388/pgb_u_change_pa_18_studierendenprojekte_nachhaltige_entwicklung.pdf (accessed 30 June 2021).

Tilbury, D. (2016), "Student engagement and leadership in higher education for sustainability", in Barth, M., Michelsen, G., Rieckmann, M. and Thomas, I. (Eds), *Routledge Handbook of Higher Education for Sustainable Development*, Routledge, London.

Trechsel, L.J., Zimmermann, A.B., Steinböck, C., Breu, T., Herweg, K. and Thieme, S. (2021), "Safe spaces for disruptive learning in a North-South research partnership context: international mobility of doctoral students", *Sustainability*, Vol. 13 No. 4, p. 2413.

UNESCO (2021), "Berlin declaration on education for sustainable development", *UNESCO World Conference on Education for Sustainable Development. Learn for Our Planet. Act for Sustainability*, UNESCO, Berlin.

Wals, A.E.J. (2020), "Sustainability-oriented ecologies of learning: a response to systemic global dysfunction", in Barnett, R. and Jackson, N. (Eds), *Ecologies for Learning and Practice. Emerging Ideas, Sightings, and Possibilities*, Routledge, Oxon.

Wals, A.E.J. and Benavot, A. (2017), "Can we meet the sustainability challenges? The role of education and lifelong learning", *European Journal of Education*, Vol. 52 No. 4, pp. 404-413.

Wals, A.E.J., Mochizuki, Y. and Leicht, A. (2017), "Critical case-studies of non-formal and community learning for sustainable development", *International Review of Education*, Vol. 63 No. 6, pp. 783-792.

Winter, J., Cotton, D., Hopkinson, P. and Grant, V. (2015), "The university as a site for transformation around sustainability", *International Journal of Innovation and Sustainable Development*, Vol. 9 Nos 3/4, pp. 303-320.

Wittmayer, J.M. and Schäpke, N. (2014), "Action, research and participation: roles of researchers in sustainability transitions", *Sustainability Science*, Vol. 9 No. 4, pp. 483-496.

About the authors

Dr Lilian Julia Trechsel is Head of the "Transformative Education and Science" Impact Area at the Centre for Development and Environment (CDE), University of Bern, Switzerland. She also coordinates the inter-university doctoral-level International Graduate School (IGS) North-South programme. Her research focuses on transformative education and the integration of sustainable development in higher education institutions and beyond, with a special focus on students' learning experiences. Lilian Julia Trechsel is the corresponding author and can be contacted at: lilian.trechsel@unibe.ch

Clara Léonie Diebold is a PhD student at the Wyss Academy for Nature and a former research associate at the Centre for Development and Environment (CDE) at the University of Bern, Switzerland. Over the past years, she has helped to build up and lead various activities to support students' engagement for sustainable development at the University of Bern. Her current research focuses on pathways towards reconciling forest conservation and human well-being.

Dr Anne Barbara Zimmermann is an Associate Senior Researcher at the Centre for Development and Environment (CDE), University of Bern, Switzerland. Since retiring in 2021, she has become a Board member of Legacy17.org and supports the COPERNICUS Alliance with a continued research and practice focus on ESD, transformative learning, transformative research and transforming the higher education system.

Manuel Fischer is Co-Head of Sustainable Development and lecturer at the Bern University of Applied Sciences, Switzerland. His teaching and research focuses on a broad area of sustainability, in particular social innovation and education for sustainable development at higher education institutions. Manuel is also a PhD student at the Centre for Development and Environment (CDE) at the University of Bern and a member of the steering committee of the U Change programme.