Teaching the “how” of transformation

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Abstract

College and university students are eager to engage with transformative solutions to the climate crisis, but often struggle to see openings or possibilities where they can leverage their actions and really “make a difference.” While climate change education often focuses on the physical dimensions of climate change and the evaluation of political, technological, and behavioral solutions, less attention has been directed to questions of how large-scale transformations to sustainability occur and how educators can help students to perceive an active role for themselves in these efforts. This paper describes an integrative learning process for teaching the “how” of transformation. This process, which we use in our undergraduate courses on climate change and society, combines the “Three Spheres” model of transformation with an active learning change experiment. A pilot assessment, conducted via student surveys and focus groups during spring semester 2020, indicated that the learning process: (1) increased the students’ understanding of transformation and their sense that transformative change is possible; (2) enhanced the students’ sense of their own agency and ability to make a difference; and, (3) helped students to articulate a role for themselves in processes of transformative change. These initial findings suggest that teaching the “how” of transformation is possible and that both understanding and experiential realization of the connection between individual and collective change are vital elements for student learning and engagement. While these early findings need to be replicated in other courses and educational settings, they offer promising indications about how universities and climate change educators can play a more prominent role in generating transformative change.

Keywords Sustainability education · Climate change education · Active learning · Integrative frameworks · Transformational learning

Introduction

How do we change the world? Most college and university students are well aware of the urgency of the climate crisis. A recent survey done in the United States, for example, found that climate change is seen as an extremely important issue for six in ten teenagers and that teens and young adults

are 10 percentage points more likely than adults to say that climate change will cause a great deal of harm to people in their generation (Hamel et al. 2019). This concern is also evident from the growing number of young people joining environmental movements globally, and demanding action on climate change and biodiversity loss (Han and Ahn 2020; Marris 2019; O’Brien et al. 2018). However, many young people are also left wondering about effective solutions to global problems. They want to understand and directly engage with transformative change, but often struggle to see openings or possibilities where they can leverage their actions and really “make a difference.”

The question of how sustainability educators and teachers can meaningfully respond to the need for transformative solutions to climate change and related environmental challenges is thus a pressing one. Climate change education often focuses on the physical processes of change, including documentation of rising emissions and empirical

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evidence of a changing climate, and then points to the promise of political, technological, and behavioral solutions (Leichenko and O'Brien 2020). While the importance of both individual and collective action on climate change is well-recognized and emphasized in sustainability education, the relationships between individual and collective change are not well articulated. For example, deliberate transformations to structures, systems and cultures are rarely linked to consciousness and worldviews (O'Brien 2013), despite a growing awareness of the need for learning approaches that focus on the transformation of unsustainable ways of *being* and *knowing* in society (Burns 2018).

In addition to conceptual understandings of “how” systems actually change, teaching transformation offers an opportunity to convey to students a sense of how they can meaningfully participate in and have an impact on large-scale sustainability transformations. Awareness of one’s ability to generate change – a sense of agency – is critical for engaging with transformative change (Otto et al. 2020). For example, a recent study surveyed 792 teenagers from Germany and Austria on climate change attitude and behavior and found a positive correlation between feelings of agency and control and levels of engagement with climate-friendly behavior and multiplicative actions (e.g., talking with family and friends about climate change). The study found that a sense of agency was a better predictor of climate action than knowledge of climate change (Kuthe et al. 2019).

As expressed throughout this Special Feature, *how* we make sense of and engage with the climate urgency matters greatly for the types of outcomes or results that are generated. Can we equip students not only with knowledge of the state of the world, but with perspectives and tools that can help them navigate these challenges and find a space to take part in creating a better future? This paper presents a pilot assessment of an integrative learning process for teaching the “how” of transformation. This process, which we apply in our undergraduate courses on *Climate Change and Society* at Rutgers University in the United States and *Environment and Society* at the University of Oslo in Norway, includes use of an integrated model of transformation in combination with an active learning experiment. The approach is intended to allow students to explore how transformative change occurs and to help them develop a better sense of their own agency and potential to facilitate broader social change. Our early findings indicate that teaching the “how” of transformation is possible and that student understanding and experiential realization of the connection between individual and collective change are vital elements for learning and engagement with large-scale transformations. While these preliminary findings need to be replicated in other courses and educational settings, they offer promising indications about how universities and climate change educators

can play a more prominent role in generating transformative change.

Teaching climate change for transformation

A recent systematic review of climate change education strategies around the world carried out by Monroe et al. (2017) finds that most programs are designed to improve knowledge about climate change science or about the causes of and solutions to climate change. Strategies that increase the success of these programs include providing information that makes climate change personally relevant and meaningful to students, and using interventions designed to engage students in active learning. Another recent international study identifies a variety of different approaches to incorporating climate change into the curriculum at the college level (Molthan-Hill et al. 2019). For example, a “piggybacking” approach integrates new modules on climate change into existing courses, and a “mainstreaming” approach brings climate change into the broader curriculum, integrating it into multiple subjects or disciplines. Other approaches involve developing new structures, such as specialized courses or degree programs that focus on topics such as adaptation and mitigation; or integration of climate change education into cross- and trans-disciplinary courses open to all students (Molthan-Hill et al. 2019).

Despite increasing calls for holistic, integrated, and relational approaches to teaching about climate change and sustainability issues, most approaches can still be considered siloed or fragmented (O'Brien et al. 2013; Sterling 2010). A singular focus on technological innovations and behavioral changes as the solutions contributes to what Shove (2010) refers to as the “attitude, behavior, and choice” paradigm for social change. This paradigm is dominant within much of the academic and political discourse and it is reflected in media coverage, which asserts that “big lifestyle changes are the only answer” to climate change (Carmichael 2019; Rowlett 2019). While both technology and behaviors are important to consider as entry points for adaptation and mitigation, they are only part of the bigger picture of transformative change. Most educational approaches pay limited attention to how behavioral changes are influenced by political structures and cultural values, often ignoring the role of the political economy, power relations, and vested interests in perpetuating certain behaviors and discouraging others (Wilhite 2016). There have also been few attempts to link critical understanding of the social processes driving climate change to individual and collective action, contributing to a perceived dichotomy between behavioral change and societal change (Leichenko and O'Brien 2020; Mochizuki and Bryan 2015). This dichotomy is evident, for example, in studies suggesting that personal actions decrease support for societal actions,

including the finding that household behavioral change crowds out support for climate change policy (Werfel 2017).

Another limitation of many approaches to climate change education is reliance on the information-deficit model of science communication where emphasis is placed on the acquisition of factual information, know-how, and expertise with the aim of “fostering the environmental knowledge, dispositions, competencies, and behavior that are vital to successful and sustainable responses” (King and Franzen 2017, p. 14). Such approaches offer limited opportunities for students to question implicit assumptions, consider multiple perspectives, and explore differences in meaning making, including different ways of framing problems, identifying solutions, and legitimizing knowledge (Hochachka 2019; Leichenko and O’Brien 2019). The information-deficit approach also pays minimal attention to the emotional facets and mental health dimensions of these issues, which are now increasingly recognized in the research literature (Verlie et al. 2020; Cunsolo and Ellis 2018; Head 2016; Sanson et al. 2019). Addressing these limitations would require acknowledgement of emotions such as frustration, anger, grief, anxiety, and sadness surrounding these issues, as well as more explicit attention to the role that emotions such as hope, connection, and love can play in inspiring and motivating climate action (Leichenko and O’Brien 2019).

While attention to how transformations to an equitable and sustainable world can be deliberately realized is limited within the field of climate change education, several other areas of sustainability education offer important insights into key elements for successful teaching of transformation. In particular, the fields of transformative sustainability education and integral education each recognize a role for self-awareness, self-reflection and incorporation of cognitive and emotional dimensions into the learning process (Mezirow 1997; Rodríguez Aboytes and Barth 2020; Wamsler 2020). Within the field of transformative sustainability education, there is an explicit emphasis on fostering learning conditions that shift assumptions and frames of reference and allow new openings for change (Mezirow 2003; Rodríguez Aboytes and Barth 2020). Diverse approaches within integral education emphasize elements such as the exploration of multiple perspectives, the weaving together of self, culture, and nature, and recognition of developmental approaches to learning. Both fields highlight the importance of critical thinking, and experiential and embodied learning, including the role of personal practices in transformation (Esbjörn-Hargens et al. 2010; O’Brien et al. 2019; Riddell 2013). Emphasizing active student engagement in a wide variety of learning experiences and experiments, these approaches are important for transcending hierarchical models of education and promoting greater openness to learning (Esbjörn-Hargens et al. 2010; Rice et al. 2015; Verlie et al. 2020). Despite these important contributions, these fields rarely link the

personal and inner dimensions with political systems and larger societal shifts, furthering the perception of a gap between individual change and collective change.

Linking transformation theory with active learning

In developing our approach to teaching the “how” of transformation, we bring together multiple dimensions of transformation and create an integrative and engaging learning process that addresses many of the limitations identified in existing educational approaches. Our process includes questioning the economic and political status quo, acknowledging the cognitive and emotional dimensions of the issue, identifying the linkages between individual action and systems change, and actively engaging with experimentation and reflections on change (Bryan 2020; Burns 2018; Leichenko and O’Brien 2020). Combining the use of an intuitive, heuristic model of transformation with active experimentation and reflection, the process provides opportunities for students to consider how individual changes can contribute to collective change, recognize multiple perspectives, and cognitively and experientially engage with transformative change (Leichenko and O’Brien 2020).

The learning process uses the Three Spheres of Transformation model to help students to visualize the interrelated nature of transformative change (Fig. 1). This model serves as a simple heuristic for understanding and engaging with transformations to sustainability by highlighting three interrelated and interacting spheres: the practical, the political, and the personal (O’Brien 2018; O’Brien and Sygna 2013). It helps students to make connections between practical actions and large-scale systems change by drawing attention to the role of social and cultural norms and institutions, as well as ways that subjectivities (e.g., beliefs, values, world-views, emotions, identities, and interests) influence change processes. For example, the model encourages students to reflect on how particular behaviors and preferences are shaped by cultural norms and societal narratives, and how these can be amplified through social relations, geographies and political structures. Besides enabling a deeper understanding of change, such an analysis also helps students to question political and social structures as givens, which opens more space for alternatives.

Within the practical sphere, a wide range of technical and behavioral changes can contribute to achieving measurable results. These might include improving the energy efficiency of appliances, driving or flying less, promoting video conferencing, eating a plant-based diet, reducing consumption, avoiding plastics, and so on. However, the success or failure of these efforts is closely linked to how society is organized within the political sphere, which refers to the structures and

Fig. 1 Three spheres of transformation. Based on O’Brien and Sygna (2013) and Sharma (2017)

systems that shape society, including norms, rules, regulations, and institutions that are often designed to maintain the status quo. Individual changes in the practical sphere can be difficult if systems are not in place to support them. For example, riding a bicycle often requires a larger infrastructure (e.g., bike lanes, showers, and parking facilities), just as reducing consumption is facilitated by institutions that promote sharing or repairing (e.g., of cars, books, clothes, tools, etc.). Practical changes may generate resistance from those that feel threatened by change, particularly those who have vested interests in the status quo or those who hold different values and worldviews. The political sphere thus closely interacts with the personal sphere, which acknowledges the importance of subjective perspectives held by individuals and groups. Attention to the personal sphere provides a space for students to explore how beliefs, values, and worldviews – including their own – influence how they relate to changes in the political and practical spheres (O’Brien 2018; Leichenko and O’Brien 2019, 2020).

The active learning component of our process involved student participation in the cCHALLENGE (<https://www.cchallenge.no/>), an experiential tool for learning structured around a 30-day experiment with a self-chosen sustainability challenge (O’Brien et al. 2019). For students, committing to a sustainability challenge that is demanding yet doable (e.g. shifting to a plant-based diet, avoiding single-use plastics, bicycling or using public transportation instead of driving) helps make the challenges of sustainability and climate change real and approachable. Drawing on

self-determination theory, dialogical action theory, integral theory, and related approaches, the cCHALLENGE aims to trigger insights and awareness about the dynamics of transformational change (Bentz and O’Brien 2019; O’Brien et al. 2019). It aims to provide students with an embodied experience of change, helping them gain a systemic understanding of how transformations can occur. While similar 30-day change experiments have been carried out in both educational and non-educational settings, the focus is more typically limited to behavioral changes aimed at reducing environmental impacts or carbon footprints (Lin 2016). Such behavioral approaches emphasize the practical sphere of transformation, with less attention to the political and personal spheres. As already mentioned, this preoccupation with the practical sphere makes invisible the many ways that practices are linked to social norms, cultural narratives and political structures, as well as to beliefs, values and worldviews.

The goal of applying the cCHALLENGE to our courses is to create a learning process in which students can explore different perspectives on the challenges of and possibilities for solutions to climate change. The use of the cCHALLENGE is grounded in a recognition of the need for students to experiment and become familiar with processes of change in a safe environment with a supportive group of co-experimenters, and with an opportunity for dialogue and self-reflection. Throughout the cCHALLENGE, students reflect about their experiences through shared discussion posts. Prompts and questions for student reflection are deliberately framed within the heuristic of the Three Spheres of Transformation (Table 1). Individual actions are thus situated within a larger context, helping students appreciate the embedded and contextual nature of individual and collective change. In this way, the experiment with change is concrete and relatable, yet does not gloss over the important political and cultural dimensions of climate change.

Methods

We conducted a pilot investigation of the pedagogical effectiveness of this integrative learning process for teaching transformation in two courses on climate change and society that were taught during Spring 2020 at Rutgers University and University of Oslo. Both courses used the textbook *Climate and Society: Transforming the Future* (Leichenko and O’Brien 2019) and both presented similar sets of lectures structured according to the chapters of the textbook. Besides presenting the science of climate change, the course lectures explored climate change discourses, different explanations for the social drivers of emissions, concepts such as vulnerability and adaptation, questions of environmental, social, and racial justice, and the role of worldviews, values and

Table 1 Questions for student reflection on the cCHALLENGE

Sphere of transformation	Illustrative questions
Practical	How do I need to organize my daily life to succeed with completing my experiment? What habits do I need to develop or release?
Political	How are social and cultural norms and expectations influencing my actions? How is my experience influencing others around me? Can I see any “ripple” effects? Where, when, and why do I experience pushback from others? What kinds of rules, regulations, incentives, or systems need to be in place to make this easier?
Personal	How do I feel about other people’s reactions to my change experiment, whether positive or negative? What assumptions do my feelings reveal? What beliefs about change am I testing? How does my change experience influence my sense of identity?

beliefs in accepting certain narratives and rejecting others. In teaching about climate change, the Three Spheres of Transformation provided a way of situating problems and solutions within a larger picture, helping students to recognize multiple perspectives and identify both nuances and blind spots.

In both classes, the cCHALLENGE began in approximately the fifth week of class. The timing for the cCHALLENGE was designed to coincide with the completion of the first four course lectures, each of which presented elements of an integrative framing of climate change, as described above. This timing ensured that students were introduced to the social and human dimensions of environmental problems prior to the cCHALLENGE, and that they were familiar with the Three Spheres of Transformation heuristic. Before starting the cCHALLENGE, students identified one personal change that addresses some aspect of sustainability. They committed to the challenge for 30 days and were asked to post or share their experiences with each other throughout the period. Students in both classes also engaged in interactive discussions of lecture content. At Rutgers, these discussions occurred during the regular bi-weekly class meetings and through online discussion posts and comment threads. They occurred in small weekly seminar sessions at the University of Oslo, which met in addition to regular weekly lectures. In both classes, web-based sharing platforms along with written assignments during the course created additional opportunities for self-reflection, sharing and dialogue among the students, all of which are foundational components of the cCHALLENGE (O’Brien et al. 2019).

Two methods were used in the assessment of the integrative learning process: 1) quantitative surveys conducted before and after the students completed the cCHALLENGE; and 2) focus group discussions, also conducted before and after the cCHALLENGE. The data collection was guided by an approved human subjects review submitted to the Norwegian Center for Research Data (NSD). The surveys were conducted via a web-based questionnaire and included questions intended to gauge the effectiveness of the learning process:

Did the cCHALLENGE give them insight into how transformation happens? Did it provide an opportunity for integrative learning? Did it contribute to their sense of agency? The focus groups were intended to provide a more in-depth look at student’s reflections on environmental issues and their learning from the course and to identify any potential shifts in thinking during the semester. Participation was voluntary and offered as a way to reflect together about topics from the course, as well as contribute to research on transformative learning. The focus group sessions were facilitated by the course lecturer and two seminar leaders for the course.

The onset of the COVID-19 pandemic presented an unexpected challenge for the two courses. The cCHALLENGE ran from late February 2020 to late March 2020, overlapping with a shift to online teaching at both universities in response to the pandemic. At Rutgers University, closure of most dorms forced US-based students to move off campus, often to the homes of parents, relatives, or friends. International students were allowed to remain in campus dorms. At the University of Oslo, there was less physical disruption for Norwegian students, as most students lived off campus. For the high number of international exchange students enrolled in the Oslo course, however, the lockdown meant ending their exchange early and returning to their home countries mid-semester. Despite these disruptions, nearly all of the students in both courses completed their cCHALLENGE. Additional questions were included in the post-cCHALLENGE survey to ask students to reflect on whether and how the learning process influenced their experience of and responses to the early phase of the COVID-19 pandemic and shutdown orders.

The pre- and post-surveys were made available on a voluntary basis to all students in the two courses. A total of 222 students were enrolled in the two courses, including 100 students in the Rutgers course and 122 in the Oslo course. Of the 137 students who completed the pre-survey, 119 students agreed to having their results included in the study. The post-survey was completed by 95 students, 76 of whom agreed to having their results included in the study.

The lower rate of participation in the post-survey may reflect greater coursework demands on students later in the semester as well as added pressures associated with the COVID-19 lockdown. Because the surveys were conducted anonymously, we were not able to track and compare specific students' pre- and post-survey participation or responses.

The focus groups were conducted with students in the Oslo course. A total of 16 students participated in three pre-focus groups held on the University of Oslo campus between February 11–19, with five to six participants in each session. One post-focus group was conducted on Zoom on April 30 with five participants. All participants in the post-focus group had participated in one of the pre-focus groups. Each focus group lasted 90 min and the sessions were recorded. The recordings were transcribed and the data was anonymized.

Before turning to the results, some limitations of the study should be noted. As a pilot study, the assessment drew from a sample of students in two courses at large, research-oriented public universities. While the nationalities and cultural backgrounds of the students in the courses are highly diverse, the students at both universities nonetheless reflect the selective admission processes at both universities. Both of the courses met undergraduate social science requirements, and the students enrolled in the courses represented a wide set of majors and non-majors, including many exchange students in Norway (as the course was taught in English). Nonetheless, the course enrollments may partly reflect a self-selected sample of students who are interested in climate change and sustainability issues and who may be more motivated to learn and engage than the typical student. Participation in the surveys and focus groups was also voluntary, and it is possible that the more engaged students in each course elected to take part in the surveys and focus groups while some of the less engaged opted out. It is also possible that students were inclined to be more positive in their reports to their instructors, especially in person but also anonymously, as compared to responses generated independently from the classes. Given these limitations, the study represents an initial assessment that needs to be replicated with a larger sample of students, representing a diverse range of colleges and universities, and including classes focused on other sustainability topics.

Results

The cCHALLENGE provided students with an opportunity to experience and embody an integrative approach to transformation via an active learning experiment with change. Students were given wide latitude to choose their cCHALLENGE experiment. The only requirement was that the challenge broadly addressed some aspect of climate change.

Students were required to post a brief description of their experiment and why they selected it. The most popular change experiments involved the reduction of plastic use and reduction of meat consumption, each of which was adopted by approximately 25 percent of students (Table 2). Other relatively popular challenges included avoiding fossil fuel-based transport by choosing to walk and bike (7 percent), reducing food waste (5 percent), as well as more contemplative experiments such as engaging with climate change through meditation and mindfulness (6 percent). Less common experiments included reducing water use, reducing energy use, spending time in nature, picking up trash, and using reusable shopping bags, each of which were adopted by one to three percent of students.

Before the cCHALLENGE

The surveys and focus groups conducted just before the cCHALLENGE explored students' initial level of engagement with environmental issues, and their understanding of their ability as individuals to have an impact. Of the 119 students in the pre-survey sample, more than 80 percent reported either high or very high interest in the challenge before it began (4 or 5 on a scale of 1–5). A vast majority of students had already engaged with pro-environmental conversations, behaviors, or activism before they did the cCHALLENGE. More than 80 percent of the students reported having tried to change a habit for the purpose of reducing their environmental impact. Out of these, a significant majority (83 percent) reported having been successful.

The pre-survey results confirmed that students were generally highly aware of and concerned about sustainability

Table 2 Types of cCHALLENGE experiments adopted by students

cCHALLENGE experiment	Number of students
Reduce Plastic Use	30
Reduce Meat Consumption	29
Green Transport	8
Meditation and Mindfulness	7
Reduce Food Waste	6
Reusable Shopping Bags	6
Picking Up Trash	5
Reduce Energy Use	3
Reduce Water Use	3
Stop Shop	3
Zero Waste	2
Eat Local Food	2
Spend Time in Nature	2
Other	13

issues before the cCHALLENGE (Table 3). More than 90 percent of the students who took part in the pre-survey reported being interested in climate and environmental issues. This high degree of interest was also reflected in strong feelings of both personal responsibility to live in an environmentally friendly way and motivation to contribute to climate change and sustainability solutions. Students also expressed a strong belief in the ability of individuals to make a difference in terms of climate change and sustainability. In response to the statement, “it doesn’t really matter what I do as an individual in relation to climate and environmental problems,” 76 percent disagreed or somewhat disagreed, while 12 percent somewhat agreed and 10 percent were neutral. Similarly, 60 percent of students disagreed or somewhat disagreed with the statement that only politicians can solve climate and environmental problems, while 17 percent agreed or somewhat agreed and 11 percent were neutral. The survey results suggest alignment between students’ sense of responsibility and personal agency and the earlier discussed notion of students desiring to influence change. However, results from the focus group discussion revealed less certainty about *how* they can make a significant difference.

In the pre-challenge focus groups, discussion of personal agency and ability to make a difference revealed a strong sense of engagement with environmental change. Several participants were involved in activist groups such as Fridays for Future and Extinction Rebellion in their home countries (Norway, Australia, Belgium, Czech Republic, Germany, and the UK). While focus group participants generally agreed that what individuals do matters, they emphasized the importance of coupling individual action with systems change. One participant articulated the need for a “both/and” perspective:

“I strongly believe that it’s this system that’s all around us that really has to change. If we forget that and think that it’s only our footprint then there’s no hope. But we have to do both and we have to be the change we want to see in the world.” (Participant L)

Despite this recognition, some questioned how strong the links between individual action and systems change really are, especially when considering the negative actions or inactions of corporations, government or other individuals. As one participant put it:

“I really believe that my individual actions matter, but I don’t believe that they impact climate change. For instance, if I switch off the lights in my room when I leave it, but in the US someone just buys an SUV or has a huge party and you consume a lot of energy and power. Small changes are nothing compared to [what] somebody can do on the other side of the Earth.” (Participant P)

Another participant touched on the different feelings associated with negative and positive actions, suggesting that negative actions carry more weight than positive actions:

“The positive things I do, I feel like they don’t matter enough, but the negative people or the negative stuff people do I feel like that matters a lot more than the positive that I do!” (Participant N)

This suggests that students carry a sense of frustration for actions that contribute to climate change, which is not counterbalanced by a sense of achievement when they take positive actions. In some cases, any sense of personal agency was tempered by fatigue and frustration about the seemingly limited impacts of these activities. As one participant described it:

“If I were to increase my engagement even more, I would have to distance myself a bit because the impact of just having it fall on, what you think is deaf ears; I wouldn’t be able to handle it I think. Already now when I try to share my engagement and people go, ‘oh yeah, that’s cool,’ or I see that nothing is happening politically, they’re opening new oil fields, that kind of stuff, I’m almost a little bit grateful that I’m not as

Table 3 Pre-cCHALLENGE interest, engagement and sense of agency

	Agree	Somewhat agree	Neutral	Some-what disagree	Disagree
I speak with friends and/or family about climate and environmental topics	54	41	13	7	4
I am interested in climate and environmental issues	81	34	2	1	1
I feel a responsibility to live in an environmentally-friendly way	66	46	6	0	1
I feel motivated to contribute to climate change and sustainability solutions	61	47	10	0	1
It doesn’t really matter what I do as an individual in relation to climate and environmental problems	1	14	13	44	47
Climate and environmental problems can only be solved by politicians	5	15	16	32	51
I do not feel that climate change and environmental problems are the most important challenges we face today	3	5	11	45	55

engaged as I could have been. Cause that would feel really hopeless." (Participant A)

Several students felt that their current situation as students presented little possibility for them as individuals to have a real impact, except through collective action. However, they could envision themselves making a difference later in life. As one participant reflected:

"I would say [I am not making a difference] yet. Because I'm a student for all of my life, I just worked in some part time jobs. I don't feel like I had the opportunity to really do something. But I still have a dream that someday I can do something. That's why I for example also joined an ecological activism group because I think that through the group I can change something. So it's more like a wish for the future." (Participant O)

In summary, the results from the pre-surveys and pre-focus groups indicate that while the students initially expressed a strong engagement, their sense of personal agency is tempered by the overwhelming magnitude of climate change and the environmental crisis. The results also suggest that students initially perceived a dichotomy between individual action and societal change, believing that their individual agency was limited to practical acts that do not necessarily contribute to larger social transformations.

After the cCHALLENGE

The surveys and focus groups conducted after the cCHALLENGE explored the impact of the integrative learning process on students' understanding of the process of transformation and sense of personal agency. Importantly, survey respondents indicated that the experience of the cCHALLENGE generally increased their sense of personal agency, with more than 80 percent feeling more capable of contributing to societal change than before they took the challenge.

This is perhaps not surprising, given that among the 76 students in the post-survey sample, roughly 82 percent ranked their commitment to the challenge as either very high or high, which is consistent with the percentage of students reporting very high or high commitment before the challenge began. The survey results also suggested that awareness of environmental challenges, sense of agency, and understanding of change were enhanced via participation in the cCHALLENGE (Table 4). In response to survey questions about the impact of the cCHALLENGE, more than 90 percent of the students agreed or somewhat agreed that participating in the cCHALLENGE made them more conscious of environmental challenges. More than 90 percent reported an increase in awareness of how their behavior is influenced by norms, regulations, and institutions.

The experiment also increased student awareness of how much *they* affect others, especially through conversations. In fact, nearly 90 percent of the students surveyed reported becoming more aware of how they influence others, and nearly 90 percent had talked with others about topics related to the cCHALLENGE. Many reported seeing changes in the behavior of family members, housemates and friends. Some reported having conversations with people about climate change and about how individuals can effect larger changes. More than 50 percent of students reported having been inspired by other students to try out other changes besides their particular challenge.

Students also reported greater awareness of their own assumptions and beliefs about change. Nearly 70 percent of the survey respondents reported having one or several "aha moments" during their challenge. These experiences varied, and reflect diverse ways that assumptions about themselves and others were challenged by the experiment. One survey respondent said:

"[My "aha-moment"] would probably be when I caught my family doing the same as me and buying groceries in bulk if it needed to be in plastic and tak-

Table 4 Post-cCHALLENGE awareness, sense of agency, and impact on others

	Agree	Some- what agree	Neutral	Somewhat disagree	Disagree
I have become more conscious of the environmental challenges we face through this project	49	23	2	1	1
I tried to change habits in other areas, in addition the challenge I chose	36	20	11	4	5
I talked with others about topics related to the cCHALLENGE	44	24	3	3	2
I became more aware of how social and cultural norms and expectations influence me	52	15	6	2	1
I became more aware of how societal structures and systems influence my behavior	44	25	5	1	1
I became more aware of my own beliefs and assumptions about change	43	27	2	4	0
I became more aware of how I influence others	35	26	11	3	1
After this project, I feel more capable of contributing to societal change	39	23	7	6	1

ing their lunch in reusable glass containers.” (Survey respondent)

In the post-cCHALLENGE focus group, discussion themes included agency and impacts on others, the connections between emotion and action, and the linkages between the different spheres of transformation. Many students were surprised by how their challenge affected others and commented on the sense of gratification that this awareness generated. As one participant said:

“One of my friends also started to look more into what he’s eating and how it is produced and where it is produced. And I was so happy when he told me that I inspired him to do this. It’s kind of a satisfying feeling to actually do at least a small change in somebody’s life.” (Participant O)

Another reflected on the importance of engaging with others by focusing on what matters to them, rather than by trying to change them:

“I feel like this course has helped me see that, sure there are some perspectives out there that (...) don’t perhaps cover as much as other perspectives, but the fact that these perspectives exist shows that there is a view out there that perceives something as an issue. That is what I try to focus on instead.” (Participant A)

Asked to write three words that best described their experience with the cCHALLENGE, the word most commonly identified by the surveyed students was “eye-opening.” One survey respondent wrote that the experience had given the feeling of “*wow I can actually do it!*” Another survey respondent wrote:

“I began to see how I, as a singular person doing the cCHALLENGE, can impact others and I saw the method behind this assignment.” (Survey respondent).

The post-focus group also included a discussion of the role that the integrative framing of the course and the Three Spheres of Transformation model had on students’ thinking about climate change and environmental problems. Students noted that the course’s integrative framing helped them identify the many relationships that are important for generating change, which not only helped in thinking about transformations but also articulating it to others. According to a focus group participant, the course “[is] giving language to understanding the transformations that have come and how you participate” (Participant M). The integrative approach provided them with a deeper perspective on transformations, and students in the focus group frequently identified the Three Spheres of Transformation as a source of insight into their own assumptions about how change happens:

“I definitely think that before I took this course, I was very much into the practical sphere of solutions. Only seeing that, not seeing beyond. So, always thinking that our problems are going to be solved by solar panels, don’t you worry! And of course, after taking this course, I realize that there are two additional, perhaps even more important, spheres that you have to keep in mind, that I hadn’t even thought about.” (Participant A)

Students also acknowledged the importance of their own emotions, expressing appreciation that the course offered a context where these could be talked about. One student reflected on how awareness combined with an embodied experience can result in feelings of personal agency and empowerment:

“[The course] made me more aware of my feelings and how to cope with them and also like, made me more like, maybe I’m going to take a Master in environment and (...) maybe commit more to my feelings (...) I knew a lot of things but I didn’t have the confidence or the faith to do it but now I feel like more empowered.” (Participant E)

Some participants reflected on how the personal is inherently linked to the political, which draws attention to the importance of explicitly connecting individual change and collective change:

“In the beginning of the cCHALLENGE, I was actually very optimistic (...) about the fact that we as an individual can make a change. At the end of the challenge, I am not thinking in the same way. It’s kind of a bit different. I still believe that we as an individual can make a change but not alone, it has to be within some kind of collective, a group of people.” (Participant K)

The importance of being part of a collective was a recurrent theme. Doing the cCHALLENGE alongside others helped students see their individual challenge as part of a larger effort, thus giving a better sense of the potential for transformative change. It also enabled students to share experiences, hopes and anxieties with fellow students and provided a venue for students to recognize and talk to others about the emotional aspects of climate change:

“I’m really happy that I’m taking this course because these emotions that come along with learning this field of study is not really talked about when you’re in the academic [world] (...) [In earlier courses] I was leaving class feeling so depressed, like everyday, learning like 20 million things that are being destroyed in this world and just heartbreak. (...) But what’s been helpful is just to hear that stated in these classes about the grief and the writing [and] hearing that other people

feel emotions around these issues and struggle with what to do." (Participant B)

By acknowledging the emotional and cognitive dimensions of the learning process, the cCHALLENGE and the course's integrative framing facilitated deeper exchanges that helped students to recognize that others struggle with similar issues.

Coping with COVID-19

The COVID-19 outbreak reached both Norway and the United States in the midst of the cCHALLENGE, meaning that the majority of students did the second part of their experiment under lockdown. Because the COVID-19 pandemic represented, in many respects, a real-time transformative experience, some additional questions were included in the post-survey to reflect students' changed circumstances. The questions were intended to explore whether and how the pandemic influenced their cCHALLENGE, as well as how their change experiments influenced their experience of the early phase of the pandemic and lockdown orders.

Survey responses indicated that nearly 75 percent of students found that the COVID-19 pandemic had affected their change experiment, while 25 percent did not experience any difference. In spite of the pandemic, rates of completion of the challenge were quite high: 63 percent of the students reported completing their challenge, while 33 percent reported completing a reduced version. In terms of overall success with the experiment, 92 percent of the students surveyed reported successfully having changed a habit during the challenge. Out of these, 49 percent were committed to keep up with the change, while another 43 percent reported being committed to a partial continuation of the change. More than a third of students found that their cCHALLENGE influenced how they were able to relate and respond to the pandemic, and several of them mentioned the synergies with practical measures for sustainability:

"I'm more conscious about where I'm getting food, doing as much as I can to reduce waste." (Survey respondent)

"I am trying to be conservative with all the products in my home so my family and I are not subjected to leaving the house." (Survey respondent)

For some students, the course helped them to see COVID in a more holistic way that is integrated with society:

"The Corona-virus is actually just another symptom of all our environmental problems. So it's really related to the whole course in a way and I think that everybody has to think, we can't start looking at the Corona-virus as this one-off thing or as this intruder in our society but it's actually part of our society and it's part of

maybe the new normal so it's really time to think about it." (Participant K)

Both survey respondents and focus group participants commented on the nature and rapidity of social transformation, noting that it challenged their assumptions about how long it takes for change to occur, and the role that they can play as individuals:

"...the entire course has had a massive impact on how I perceive society, transformations, and the future. Viewed through the lens of the three spheres and the nature of change and social innovation in particular, it is very striking to see the mobilization and societal response to the pandemic. It is a change that is as profound as it is sudden, and I am so thankful to have the privilege of being in this class at this moment, when we're living through society-wide habit changes that in a significant way resemble what we're discussing in class. I am so appreciative for this valuable contextualization the course has provided in a time of great uncertainty and anxiety; it has been a great source of optimism and hope for me. With its focus on all the dimensions of change, and the light and dark sides of transformation, I feel empowered to take part in a rapidly changing society without shying away from the bad or scary sides, and go into the future with my chin up and my eyes open." (Survey respondent)

Key lessons

The results from both the surveys and focus groups suggest that students experienced shifts in their thinking that went beyond simply becoming more aware of environmental issues. Results indicate that the change experiment and the ability to make sense of own experiences through a heuristic like the Three Spheres of Transformation helped students situate their own challenge in a bigger perspective. In addition to recognizing how changes happen across the practical, political, and personal spheres of transformation, many students also experienced an ability to articulate a role for themselves in engaging with the process of transformative change.

Results from the pre-surveys and pre-focus groups highlighted an important mismatch between feeling responsible and motivated to address climate change, versus feeling capable and empowered to do so. The results from the post-surveys and post-focus groups, however, show promising signs of the lessening of this gap by enhancing feelings of agency and capacity to engage with complexity. Summarized, the results show three interrelated realizations among students:

1. Changes that generate transformational outcomes happen across multiple, interrelated spheres;
2. Transformation is an inherently social process that links individual and collective action; and,
3. Individuals have the capacity to engage with transformational processes by reflecting and acting on shared values, connecting with and influencing others, and shifting systems.

These findings suggest that our approach responds to several of the gaps associated with climate change education, including the tendency to limit analysis to disciplinary silos, the perceived dichotomy between individual and collective action, and the limited recognition of the role of emotion in motivating action. The student reflections also suggest that our learning process provided students with some tools to understand and respond to the initial COVID-19 lockdown. In particular, the process offered a lens that allowed students to see their own agency and potential to contribute to larger-scale transformations. These findings are tempered, however, by recognition that the COVID-19 pandemic was still in a relatively early phase when the courses ended in May 2020. Exploring the longer-term effects of our learning process on student understanding and engagement with transformation is an important area for further study.

Conclusions

Despite tremendous student interest in climate change, the education sector remains underutilized as a strategic resource for climate change mitigation and adaptation, including within the wider context of education for sustainable development (Burns et al. 2015; Kwauk 2020; Mochizuki and Bryan 2015). While fields such as transformative sustainability education have put more emphasis on engaging the inner dimensions of sustainability, there is still a need for more integrative approaches that link individual change with societal change (Leichenko and O'Brien 2020; Wamsler 2020). Teaching the “how” of transformation can be facilitated with both frameworks and tools that help students to approach climate change in a holistic manner that engages them personally, and allows to see themselves as active agents capable of influencing larger systems (Leichenko and O'Brien 2020; Petersen and Barnes 2020).

The learning process presented in this study combined an integrated model of transformation with an active learning experiment. The approach provided space for students to think critically, question assumptions, see themselves differently, and explore their role in social change processes. In addition to the linkage of the Three Spheres model with the cCHALLENGE experiment, which was reinforced through course lectures and readings, other key elements

of the process included a low-bar experimental framing, a supportive group of co-experimenters, and creation of in-person and online opportunities for reflection and sharing. While the two courses in this study focused on the issue of climate change, a similar integrative and active learning process could be adopted in different types of classes with different emphases, such as environmental and racial justice, biodiversity, conservation, agroecology, global health, and urban environmental change. Indeed, integrative pedagogical approaches could be applied to nearly every social issue that calls for a broader and deeper understanding of transformative change.

If universities are to play a more prominent role in catalyzing transformative climate change responses, it is important to recognize that the success of integrative approaches are also crucially dependent on the educator. As facilitators of integrative learning processes, instructors need to be self-reflective in their use of materials and approaches, embodying strategies such as deep listening, honoring partial truths, exploring blind spots, and guiding student thinking across all three spheres of transformation. In other words, fostering a sense of agency and engagement with the “how” of transformation is just as important for teachers and other sustainability educators as it is for students. Seizing the opportunity to engage with transformative change entails a continuous process of inquiry, dialogue, critical reflection, and action for both educators and students.

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