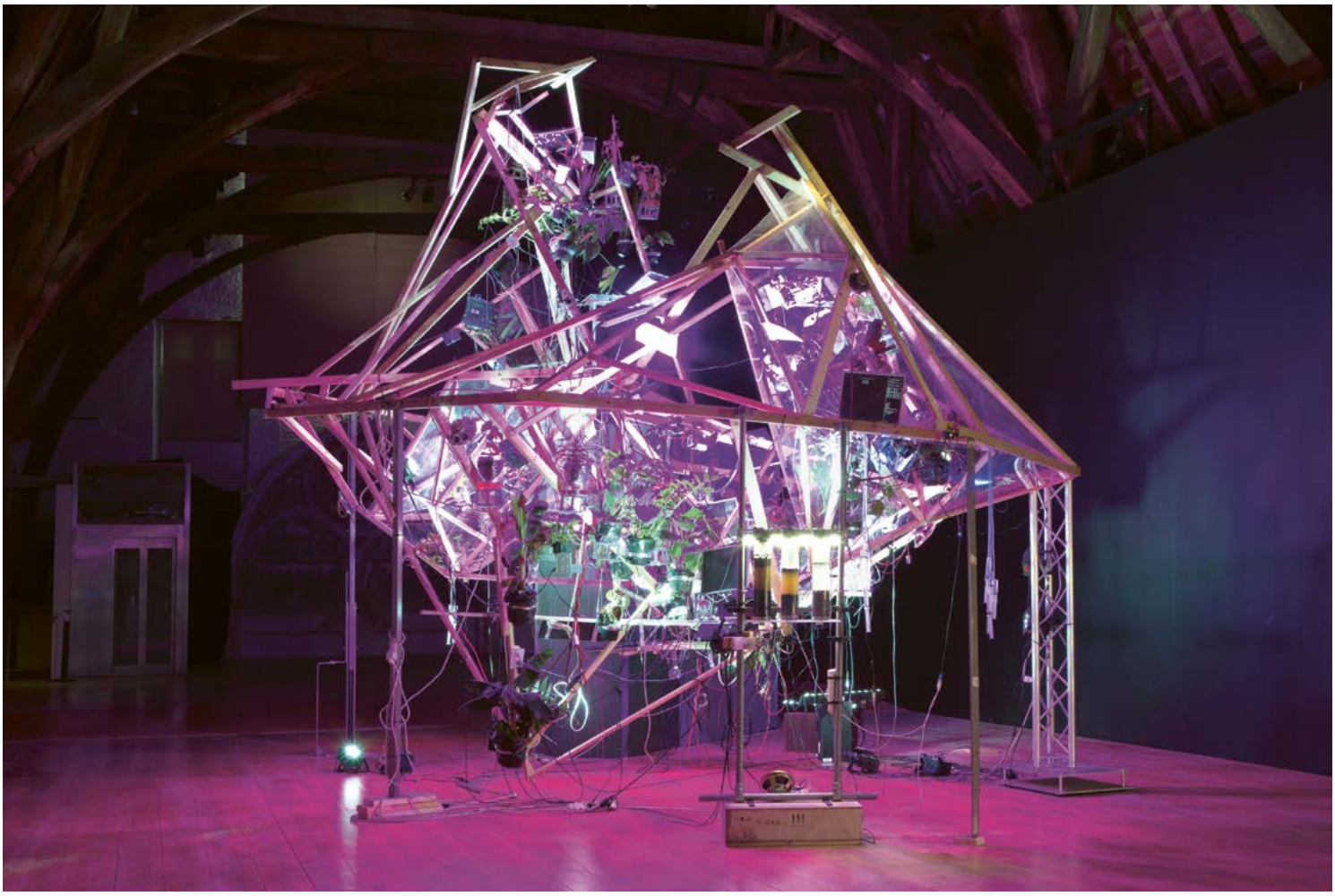
THE**TRANSDISCIPLINARY**JOURNAL
1 | 2023

GAiA

ECOLOGICAL PERSPECTIVES FOR SCIENCE AND SOCIETY
ÖKOLOGISCHE PERSPEKTIVEN FÜR WISSENSCHAFT UND GESELLSCHAFT



FOCUS CREATING SPACES AND CULTIVATING MINDSETS FOR TRANSDISCIPLINARITY

KEINE ENERGIEWENDE OHNE ATOMWENDE

GAIA is available online at *www.ingentaconnect.com/content/oekom/gaia*
www.oekom.de | B 54649 | ISSN print 0940-5550, online 2625-5413 | GAIAEA 32/1, 77 – 212 (2023)

oekom science

Teaching transdisciplinary competencies for sustainability transformation by co-producing social learning videos

Film has great potential to initiate social learning processes. Therefore, working with film is suitable as a teaching format that enables co-production of knowledge and transformative learning. Through participatory filmmaking, students can acquire transdisciplinary competencies, which are necessary for sustainability transformations. We discuss how transdisciplinary competences can be acquired by building on transformative teaching by co-producing social learning videos.

Susan Thieme, Patricia Elizabeth Fry

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GAIA 32/1 (2023): 154–161

Abstract
Dealing with complex societal problems requires transdisciplinary approaches and competencies. Inspired by debates on transformative teaching and participatory filmmaking, we show how we used the social learning video method to teach transdisciplinary competencies in a university setting. Using the design of future railway stations as an example, students interacted with external practice partners in real-world problem situations. As part of this process, they became aware of their own professional perspectives and critically reflected on the perspectives of their practice partners and the differences in their understanding of sustainability. In addition, they developed numerous transdisciplinary competences, such as defining a problem together, conducting group discussions and interviews, mediating among different viewpoints, allowing a common language to develop, and triggering "AHA!" moments in joint film screenings. As part of transdisciplinary and transformative teaching, it is important to provide access to external practice partners and working environments, enable students to engage and reflect, and provide nurturing and challenging framework conditions.

Keywords
filmmaking, social learning video method, transdisciplinarity, transdisciplinary competencies, transformative teaching and learning

Prof. Dr. Susan Thieme | University of Bern | Institute of Geography | Bern | CH | susan.thieme@giub.unibe.ch

Prof. Dr. Patricia Elizabeth Fry | Bern University of Applied Sciences (BFH) | School of Agricultural, Forest and Food Sciences (HAFL) | Abteilung Studiengangsübergreifende Disziplinen | Zollikofen | CH | patricia.fry@bfh.ch

https://doi.org/10.14512/gaia.32.1.13
Received June 14, 2022; revised version accepted March 14, 2023 (double-blind peer review).

Co-producing knowledge with and for society

Societal challenges such as climate change, mobility injustice, and forced migration call for transdisciplinary research where actors from the fields of research, civil society, administration, and the private sector can co-create knowledge (Hirsch Hadorn et al. 2008, Jahn et al. 2012, Klein 1996) for societal transformation (De Jong et al. 2016, Pohl 2011, Schneider et al. 2019, Schneidewind et al. 2016). Transdisciplinary research requires distinct methods and competencies to facilitate the co-production of knowledge (Bammer et al. 2020, Hoffmann et al. 2019). We argue that higher education should empower students with transdisciplinary competencies to enable them to deal with real-world problems in their present and future working environments.

While transmissive education (Blake et al. 2013) is designed for knowledge transfer and disciplinary thinking, transformative teaching highlights engaging with the normativity of research for sustainable development, inter- and transdisciplinarity, as well as learner and competence orientation. This leaves scope for contributions to shape and implement transformative teaching (Förster et al. 2019, Zimmermann et al. 2021).

As an example, we describe a dedicated annual master's course in geography that deals with mobility and sustainable regional development. To create a transdisciplinary research process, students implemented the social learning video (SLV) method (Fry 2018, 2021, Fry and Thieme 2019), which enhances co-production of knowledge and joint learning processes by working with film. Hence, we address the following research questions herein: "How can we translate a research method into a teaching format that enables knowledge co-production and transformative learning in a university teaching setting? What kind of transdisciplinary learning processes do participants in this seminar experience?"

This paper contributes to debates on transformative teaching, particularly on how to implement transformative teaching within the disciplinary confines of a university setting. We ex-

TABLE 1: Social learning video method in teaching: allocation of work in the seminar. Draft Fry and Thieme (2021, p. 284).

MODERATION GROUP	FILM GROUP	EDITING GROUP
■ organisation and moderation of external practice partner group discussion	■ film concept ■ filming external practice partner group discussion, additional interviews in the working environment of external practice partners	■ editing film material (figure 1, p. 156) ■ presenting an intermediary rough cut with all practice partners ■ post-production: title, music
ALL GROUPS		
■ reading on sustainability, mobility, forms of knowledge ■ final presentation and discussion of the film with all practice partners, and oral and written reflection on video content		

plore the potential of a film-based method of engagement with various external practice partners, which leads to mutual learning and potential transformation.

The data presented here are based on the SLVs produced during seminars in 2019 and 2020 – all filmed seminar sessions, including the all-practice partner discussions on the first, intermediate, and final version of the films. The all-practice partner discussions and the two final presentations as well as the student reflections from the other filmed seminar sessions were fully transcribed. However, the lecturer's inputs as well as the technical and organisational discussions by students were not transcribed.

Further, the data were analysed in an approach inspired by the grounded theory (Strauss and Corbin 1998), using open and axial coding with a focus on general themes relevant to processes related to transdisciplinary learning. In the first round of open coding, a substantial number of codes were developed to name and describe the study phenomena. Then, categories that resulted from open coding were refined and differentiated; thereafter, relationships were created among these categories (Flick 2018, Strauss and Corbin 1998). For this article, we focused on learning experiences from students and practice partners. Additional information was drawn from the seminar syllabi, teacher's notes, students' written reflections, and seminar evaluations. All participants were informed at the beginning of the seminar that all sessions would be filmed and potentially used for the SLV and further analysis in an anonymized manner. For both videos – *No space at Thun station: Searching for sustainable development of space* (2019) and *Bahnhof Olten: Kooperation in Beton gegossen* (2020) –, all students and teachers are listed as equal authors.

The remainder of this paper is structured in the following manner: In the next section, we present an introduction to conceptual debates on transformative learning and on SLV as an applied research method. Thereafter, we focus the results on the translation of the SLV method into a teaching format, and evaluate the reflections on transdisciplinary learning processes by students and external practice partners. Finally, we conclude by summarising the learning experiences and discussing what is needed to develop teaching transdisciplinary competencies through film using the SLV method.

Transformative teaching and participatory video making

This research is grounded in two debates: transformative teaching and learning, and participatory video making.

Transformative teaching and learning are rooted in the transformative learning theory and challenge and transform the very basic premises of our actions and thoughts. Becoming critically reflective about one's own assumptions is key to transforming one's taken-for-granted frame of reference, thereby enabling learning to adapt to change (Taylor 2017, Mezirow 1997, Mezirow and Cranton 2012), which is also referred to as "third-order" learning (Balsiger et al. 2017).

As Mezirow (1997, p. 7) stated, "We transform our frames of reference through critical reflection on the assumptions upon which our interpretations, beliefs, and habits of mind or points of view are based". Therefore, teaching must address cognitive, physical, emotional, and social dimensions and enable participation, integration, and reflection (Förster et al. 2019). To support students during the disruptive liminal phase (Pearce et al. 2022, Balsiger et al. 2017), teachers must provide safe spaces for learning (Singer-Brodowski et al. 2022, Trechsel et al. 2021).

The SLV method builds on the principles of *participatory video making*, which focus on the possibilities of film as an integral, >

In summary, our teaching experience enabled us to better understand how we can contribute to transdisciplinary and transformative teaching as well as enable students to acquire essential competences to deal with complex societal problems: through activating teaching formats as well as nurturing and challenging framework conditions.

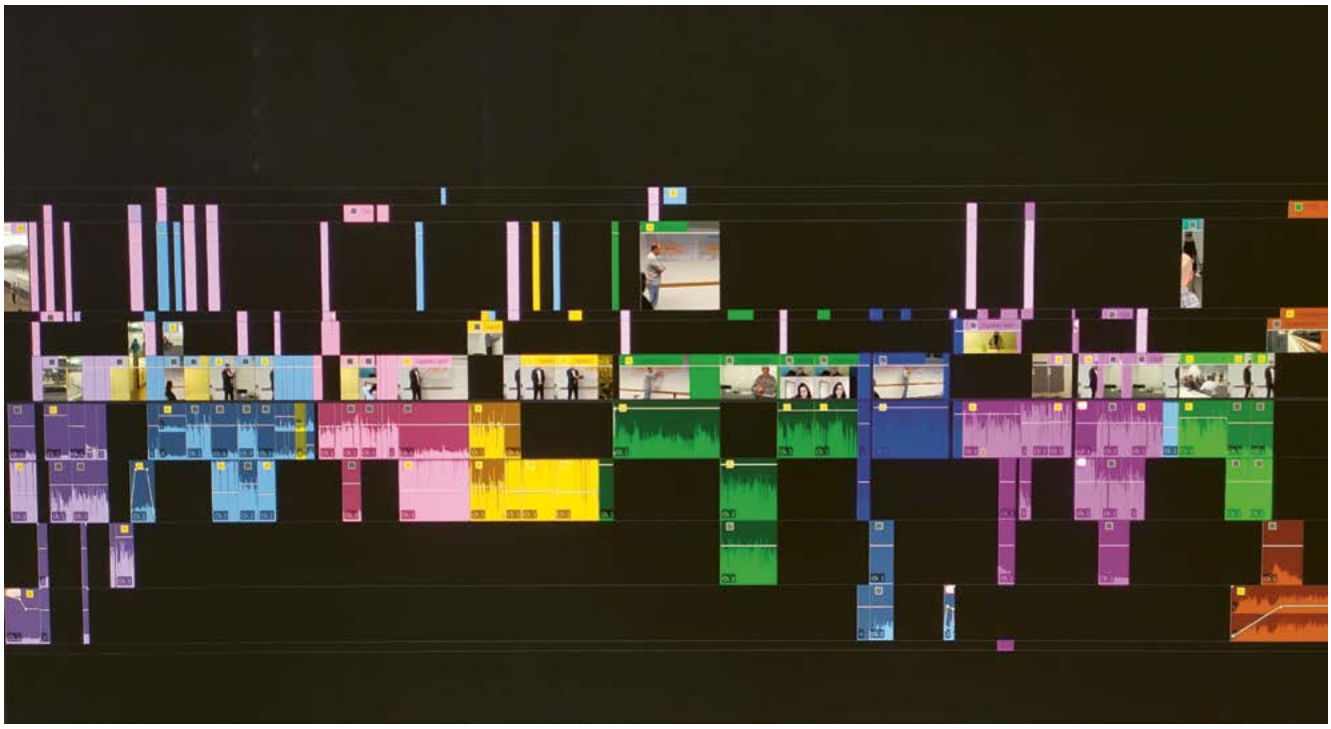

FIGURE 1: Screenshot from the film editing "work in progress" by the editing team (table 1). Source: S. Boog, member of the editing team in 2020.

reflective, and participatory aspect of the research process (e. g., Berardi and Mistry 2012, Garrett and Brickell 2015, Jacobs 2016, Kindon 2016, Parr 2007, Thieme et al. 2019). Film has great potential to initiate social learning processes individually as well as within groups. Working with the camera enables interaction, negotiation, and reflection with regard to power and representation throughout the filmmaking process (Kindon 2016, Garrett and Brickell 2015, Thieme 2012). Because of the synchronicity of its visual, sensory, and performative aspects (Barbash and Taylor 1997, Ambühl 2018), film is more accessible to people than textual data (Angelone 2019). Furthermore, film screenings allow researchers, protagonists, and the audience to encounter one another; this enables a critical reflection on the content and process of filmmaking, thereby facilitating further research in the field.

The SLV method utilises these potentials; the method was developed by Fry (2018) to foster social learning (e. g., Rist et al. 2006, Wals 2007) among farmers on sustainable soil use. The aim of this method is that actors from science, administration, and other fields of practice co-produce authentic videos with target group-specific transformation knowledge (Wuelser et al. 2012) including their "AHA!" moments (Pearce et al. 2022). These should accompany the following stages of film co-production: 1. practice partner discussion groups and selection of means for transformation and suitable cases (Fry 2021); 2. interviews regarding crucial learning processes for sustainable practices; 3. film concept and feedback from the external practice partner group; 4. production of a rough cut; and 5. discussion of the final film in moderated groups. Transformative learning takes place during all these steps as well as when the films are viewed in all kinds of working contexts such as trainings, workshops, working groups and meetings (Fry 2018, Fry and Thieme 2019).

Implementation of the social learning video method in teaching

The course is an open, annual, semi-obligatory seminar in geography and critical sustainability studies for a maximum of 20 students. The only preselection criteria are substantial preparatory reading and written reflection before the seminar begins. The course has the following learning goals:

1. Reflect on concepts related to sustainability, mobility, transdisciplinarity, and the SLV method.
2. Apply the concepts of "sustainability" and a transdisciplinary approach to a problem formulated with practice partners.
3. Analyse and reflect on different actors' perspectives and forms of knowledge.
4. Test and critically reflect on the SLV method.

In preparation for the seminar, partners from the Swiss Federal Railways (SBB) and teachers selected mobility hubs with high regional relevance and accessible background material, located within easy reach of students for their empirical work. Over the period of a twelve-week semester, 20 students were divided into three working groups and went through the entire process of

FIGURE 2: Triggering transdisciplinary learning processes: using the development zone plan to develop future mobility hubs. Subtitle: "Is everything we thought earlier right?" (Video still, with permission by M. Neuenschwander, depicted. *Bahnhof Olten: Kooperation in Beton gegossen,* 2020, 10:54).

producing an SLV, thereby co-producing knowledge with all their practice partners (table 1).

The assessment included three written reflections on the student's learning processes, with key questions on readings, transdisciplinary working processes, and different forms of knowledge produced during the seminar as well as during the video production process; a critical assessment of the SLV methodology was also required.

Triggering transdisciplinary learning processes

In the following account, we discuss the transdisciplinary learning processes initiated during the co-production of the SLV, first, from the perspective of students, and, second, from the perspective of external partners.

Learning processes from students' perspectives

Through the creation of the SLV, students experienced an authentic negotiation process among representatives of the SBB and other practice partners on the development of a future mobility hub (figure 2).

Students critically reflected on concepts such as "planning" or "sustainability," thereby leading them to "AHA!" moments in terms of complexity and long-term planning.

> *What really shook me: [...] the whole complexity of the process. It is very impressive to see which actors are involved behind-the-scenes and on the other hand [...] the long-term aspect. You plan something today and who can guarantee that in 50 years it will still be desirable?*
>
> Student 1, 2020

Bell et al. (2013) confirm that learning as part of an authentic context can be effective. In the next example, it is evident that students became aware of their own professional perspectives, potentially leading to second-order learning, thereby implying critical reflection (Balsiger et al. 2017, p. 358).

> *I became aware of the big gap between university and practice when we quite naturally wanted to march into the discussion with our concept of sustainability and make it the core of the video. It sensitised me to first want to understand the world of the actors, their goals and concerns.*
>
> Student 2, 2019

In the second half of the above quote, critical reflection brings the student to want to understand the perspectives of other actors and their concerns. We argue that this hints towards third-order learning, because the speaker's own world view is transformed (Balsiger et al. 2017, p. 358, Pearce et al. 2022).

Further, students explored different perspectives on sustainability within the SBB and brought to light the social, economic, >

and ecological dimensions of sustainability visible and audible in the film. Within these perspectives, they critiqued a rather vague understanding simultaneously with a deep engagement with the topic. They also revealed questions of power and critique from within and outside the SBB with respect to who participates in the planning and decision-making process in such complex institutional settings and who does not.

Producing the SLV enabled the students to reflect on the aims and interests of the actors. They realized that even within the institution of SBB, it was necessary to bridge siloed thinking between the divisions for infrastructure and real estate as well as different levels of management, for example:

> *[...] many actors have different demands for using the limited space, and that a solution can only be negotiated in a sustainable way if all actors involved disclose their knowledge and demands.*
>
> Student 3, 2019

The participating students recognized the development zone plan as "a link between the stakeholders". They saw how this development zone plan brought to light differing views and enabled participants to explore new ideas for solutions. During the group discussion, one of the practice partners from the city of Thun used "interface paper" as a metaphor for a combined effort and translation of different views. A student reflected:

> *[...] in this short time [...] something essential has happened. A small, very central commonality has developed, a term [created] in this group, the "interface paper". [Like this] a specific, common language starts to develop.*
>
> Student 2, 2019

Owing to the medium of film, they also shared images of meaningful and authentic situations at the stations Thun and Olten and linked these with the topics negotiated in the development zone plan. During the editing process, students reflected on their own positionality and power relations as well as on who speaks for whom in the film material (Richardson 2022, Heinrichs 2018). They decided against using a voice-over and instead let people have their say to better represent meaningful situations and social learning processes among different actors:

> *[...] it's not really about it being an explanatory video. It's more about showing a process: what we have done and [...] the process that the SBB and the city and the other actors are involved in.*
>
> Student 5, 2020

Co-producing a film facilitates the sharing of participants' perspectives and critical reflection through the collective review process (Richardson 2022).

The insights from the students revealed how they interacted with external practice partners in authentic places of work and in real-world problem situations. Moreover, the students also became aware of their own professional perspectives. Through that experience, they analysed and critically reflected on the perspectives of their practice partners, thereby activating essential transformative learning processes (Fry and Thieme 2021, Balsiger et al. 2017, Kristof 2010). For instance, they experienced how their disciplinary view of sustainability shifted into a transdisciplinary manner of working with different practice partners and how knowledge can be co-produced through film making. They also developed transdisciplinary competences like defining a problem together, conducting group discussions and interviews, mediating among different viewpoints by means of, for example, the development zone plan, thereby allowing for the development of a common language and triggering "AHA!" moments in joint film screenings (Pearce et al. 2022, Fry and Thieme 2019).

Learning processes from the perspectives of practice partners

Alongside the students, the SBB representatives and other external practice partners acknowledged to have profited from the seminars as well, which sits at the core of co-production of knowledge in a transdisciplinary setting (Hoffmann et al. 2019). They experienced that the participatory process of creating and reviewing the SLV facilitated critical reflection (see Richardson 2022) on their personal and institutional perspectives as well as how they relate to external partners. In both videos, external practice partners revealed and analysed the challenges of both mobility hubs. This situated knowledge (McLellan 1996) could be relevant for managers developing strategies, as one of the SBB practice partners in the group discussion reflected:

> *The problem areas are underlined with the pictures [...] and I think the people who work out the strategy [...], know the situation very cursorily or maybe not at all. [They] would learn a lot more about the station [...]. [The film] will create a lot of clarity, not only for me, but also for our management levels.*
>
> H., SBB Infrastructure, 2019

Richardson (2022) states that participatory videos reveal practices, interactions, and contextual information which are not easily conveyed through other formats such as in written texts.

The film had the potential to support SBB specialists in bridging siloed thinking and understanding other external practice partners, as stated by a representative from the infrastructure division:

> *I usually only hear the internal SBB voices, either from the infrastructure side or maybe also from the real estate side. I liked hearing an urban planner and a representative of IG Velo [bike transit advocacy group]. Then the architect, who tries to present the big picture comprehensively. I think that's good and can also help to create understanding among our employees who deal with the topic of the railway station in a specific role.*
>
> R., SBB Infrastructure, 2020

Working with film encourages to concretize, contextualize, and condense complex phenomena thereby allowing a more comprehensive, cognitive, and intuitive understanding of the matter (Heinrichs 2018).

Another SBB employee saw the potential of these films in triggering "AHA!" moments within their institution:

> *If you have worked differently for 20 years than what is required now, you can't change that overnight. [...] [W]ith the video, that will at least have such an "AHA" effect for a lot of people in our institution now.*
>
> M., SBB, 2019

The film also highlighted the role of SBB in stewarding co-creation processes in the future:

> *I thought the film [...] made a central service very transparent and visible, namely the facilitator role: bringing the various stakeholders around the table [...] and then generating a co-creation process, [...] so that something bigger can emerge. [...] [Now] I have a tool to promote these issues.*
>
> A., SBB, 2020

For the different external practice partners, the seminar setup facilitated dialogue and reflection on their often-siloed thinking and led to a better understanding of other relevant viewpoints of their practice partners. This also enabled external practice partners to reflect on different dimensions of sustainability that were discussed and the potential of using these films in triggering more "AHA!" moments.

Conclusion: What is required for teaching transdisciplinary competencies

Identifying solutions to complex societal problems requires transdisciplinary approaches and competences. Drawing from our own research experience with the SLV method, we wanted to translate this research method into a transdisciplinary teaching format and explore what kind of transdisciplinary and transformative learning processes can be experienced in a regular university setting. Based on debates on transformative teaching and learning and participatory filmmaking, we discovered the following learning experiences among students and external partners. Students became aware of their own professional perspectives and critically reflected the differences in their understanding of sustainability. Practice partners reflected their personal and institutional perspectives as well as how they relate to external partners.

Students are challenged by the complexity of the topic, the diversity of tasks and expectations, working independently, and dealing with uncertainties. The broadness of these learning goals often conflicts with curricular, discipline-specific, in-depth learning objectives as well as with a tendency to favour competition over collaboration. A few students experienced tensions between their expectations of objectivity and more appropriate reflection regarding situated, peer-related intersubjective validity (Balsiger et al. 2017, Singer-Brodowski et al. 2022, Heinrichs 2018, Förster et al. 2019). Collaborating with students and practice partners – each with their own working logics and expectations – increases complexity, uncertainties, and the need for flexibility. Working together towards creating a final video creates a high dependency on numerous people from different organisations, often within a tight time frame. This is particularly challenging when there is a phase of disorientation, which is necessary for transformative learning (Förster et al. 2019). Part of the process can certainly be planned, but part of it only evolves during the creative process.

Therefore, we conclude this article with a description of certain conditions that are required for transdisciplinary teaching. The first is enabling the interaction between students and external practice partners in a real-world problem-solving setting: visiting places and reflecting on views, methods, and contexts of social learning. The second is developing a teaching format that addresses the challenges of transdisciplinary research and enables students to engage, try out, and reflect on various aspects. The third condition is the need for intensive support from teachers to facilitate the diversity of actors and tasks. Teachers should have a strong commitment towards coaching, moderation, and flexibility, thereby enabling students to take responsibility and acquire knowledge themselves through discussing, writing, interviewing, filming, and editing with their peers and coaches. For this role as coaches, the conceptual and procedural competences of teachers become more important. They benefit from trusting the skills and knowledge of external actors and students, meeting them eye-to-eye, and sharing knowledge and experiences. McLellan's (1996) model of instruction, based on situated learning, emphasizes the importance of social interactions during the learning process, where cognitive apprenticeship, coaching, multiple opportunities for practice, collaboration, and reflection are the key components (see also Kuchner et al. 2023, in this special issue).

In summary, our teaching experience enabled us to better understand how, through activating teaching formats as well as nurturing and challenging framework conditions, we can contribute to transdisciplinary and transformative teaching as well as enable students to acquire essential competences to deal with complex societal problems.

Acknowledgement: We are grateful to all our practice partners and all students for their strong engagement in the co-production of the described teaching format. We would like to thank two anonymous reviewers for their very helpful comments.
Funding: We thank the University of Bern, CH, for having supported the seminar under the scheme *Promoting Sustainable Development in Teaching* as well as the Swiss Federal Railways (SBB) for co-financing one of the teachers as well as teaching assistants for one of the seminars. With the described teaching format the authors received the *Prize for University Teaching 2021* in geography awarded by the Association of Geography at German Speaking Universities and Research Institutions (VGDH).
Competing interests: The authors declare no competing interests.
Author contribution: This paper is based on a collaborative writing process. *ST* had the lead for the writing process and in setting out the conceptual framing. In the process of writing *ST* and *PF* equally contributed to the conceptual and empirical part of the paper. The paper is based on a collaborative teaching project where both authors equally contributed.
Ethical oversight: The authors ensure that all procedures were performed in compliance with relevant laws and institutional guidelines.

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Susan Thieme
Studies in geography, sociology and political science. 2005 PhD and 2012 Professorial Thesis (habilitation) at the University of Zurich, CH. 2015 to 2017 professor for geography at Freie Universität Berlin, DE. Since 2017 professor for geography and critical sustainability studies at the University of Bern, CH. Founder and co-leader of the mLAB, a collaborative space for academia and arts. Research interests: societal transformation and sustainability at the intersections of migration, im/mobility, labor and education, transdisciplinarity, and the role of social sciences and art in social-ecological transformation processes.

Patricia Elizabeth Fry
1990 Dipl. zool. at the University of Zurich, CH. 2000 PhD on perception of soil quality by farmers and scientists at ETH Zurich, CH. Since 2001 own enterprise Wissensmanagement Umwelt GmbH. Since 2021 head of research of cross-curricular disciplines SüD and lecturer for extension and knowledge exchange at the School of Agricultural, Forest and Food Sciences (HAFL), Bern University of Applied Sciences (BFH), Zollikofen, CH. Research interests: co-production between sciences, administration, and practice; transformation with social learning video; teaching transdisciplinary methods and skills.