

A Paradigm Change: Introducing Transition Design to Interaction Design Students

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1 Introduction

In January 2022, the three authors of this chapter huddled together to discuss the upcoming run of the transition design course (translated as *transformativt design* to Norwegian) at the University of Oslo, taken in the spring semester of the last year of the bachelor's program in Design, Use and Interaction. The course started running in 2020, shaken by the breakout of the COVID-19 pandemics. In 2021, the course was offered entirely online, and now – in 2022, face-to-face teaching was possible again. Despite hurdles concerning such a rocky start, we were excited about the course and what it has to offer. The focus was no longer only on learning outcomes but also on teaching students to think differently about the role of design and designers and their power to mitigate growing challenges of the 21st century (health, environmental and biodiversity derision, climate change, sustainability, and others). Opening for alternate philosophical perspectives, theories from multiple fields of research, or envisioning desirable futures with more socially just and environmentally friendly worlds to live in, there was always a plethora of topics to deliberate on and consider including in the course.

We first became aware of transition design after reading the manifesto by Irwin et al. (2015). The manifesto presented a transition design framework, a broad range of related topics and ways of thinking, and inspiring literature to broaden the perspective on any topic that the manifesto discussed. It did not take long before we started using the framework in research and teaching (Culén & Stevens, 2022; Karahasanović et al., 2020; Srivastava & Culén, 2018, 2019).

Transition design is described and positioned in the introduction to this book as the advanced form of holistic thinking and systemic design, focusing on ecological sustainability and the conscious and timely design of futures desirable for humanity and the planet. In this chapter, we argue – similar to Meyer & Norman (2020) – that the role of design and designers has changed significantly during the past few years. Design is increasingly recognizing its contribution to creating the challenges of our time, such as overconsumption and its implications on the environment, but also its potential to be a powerful force in mitigating such challenges. Rittel and Weber (1973) characterized complex problems such as the 21st century challenges concerning social justice, climate change, poverty, or peace as ‘wicked’, implying that they represent systemic, intertwined problems contextualized within broad societal frames and tightly related to current socio-technical-ecological systems. Aiming to define spaces within which we might want to seek solutions, Raworth (2017) suggested doughnut economies, and Steffen et al. (2015) planetary boundaries as places where the economy is taking into consideration both social and planetary issues and, thus, represent safe and just spaces for the design of possible futures.

However, design education is still rather traditional, and, in the words of Meyer and Norman, “*Many design programs still maintain an insular perspective and an inefficient mechanism of tacit knowledge transfer*” (2020, p.1). Such education might be a factor in perpetuating problems, for example, consumerism. After all, our field of research and design practice, interaction design, is about the design of new digital artefacts and ways of interacting with them. Until relatively recently, for example, the scarcity of materials used to manufacture digital products was not a major concern; rather, the interaction design community focused on users’ satisfaction and experiences with new products. That is, fortunately, changing. It is worth mentioning Tony Fry’s words, “*We are finite beings living on a finite planet with finite resources that we squander at the speed of light, in geological terms*” (2011), which hopefully instantly bring about the realization that continuing on such a ‘squandering’ trajectory makes no sense. Thus, the question that arises naturally is: how

to educate new generation of designers, including those working with digital materials like interaction designers, who would be able to move away from being part of the problem to being part of the solution? In this chapter, we provide the answer that we came up with – one of many possibilities for engaging with design education transitions, but the one that might provide a voice in the upcoming debate on the topic.

The chapter is structured as follows: in the next section, we provide background on significant movements that are currently changing education in general and design education in particular, including interaction and transition design. In Section 3, we describe how we started working with the transition design course and how we conceptualized it, including choices such as using real-life projects, teamwork, constructivist and experiential learning, and balancing critical thinking and reflection with concrete activities that comprise a design practice. Section 4 provides examples of student projects over the last three years. Section 5 describes challenges met by students and our reflection on those challenges and ways of mitigating them. Finally, we conclude the chapter with a summary of the most important points concerning our experiences with teaching transition design courses.

2 Background

With the recognition that modern challenges are growing in numbers and complexity, there came a recognition that general education and, especially, design education require re-thinking. What knowledge and skills are needed to meet these growing challenges? Several initiatives have acknowledged the importance of education to empower change in the future. In this section, we consider 1) some conceptualizations of alternatives to traditional education that emerged before transition design but shared some common concerns – engaged scholarship, responsible education, and transdisciplinarity; 2) interaction design education and its more recent concerns, and 3) the efforts to change design education through transition design.

2.1 Conceptualizing new ways of educating students

The **engaged scholarship** movement was conceptualized a bit over a quarter of a century ago and rested on the idea that educational institutions need to develop solutions that match current and pressing civic, social, economic, or ethical problems, rather than being places “*where students get credentialed and faculty get tenured*” (Boyer, 1996, p. 14). With growing challenges, higher education institutions stand in front of even more formidable tasks of reconciling teaching, research, and societal commitments than when engaged scholarship first emerged. Although discussed mainly in terms of research, the engaged scholarship also includes engaged teaching and service, representing, still today, an alternative to traditional academic practices. Boyer expressed it as follows: “*I have this growing conviction that what’s also needed is not just more programs, but a larger purpose, a larger sense of mission, a larger clarity of direction in the nation’s life as we move toward century twenty-one. Increasingly, I’m convinced that ultimately, the scholarship of engagement also means creating a special climate in which the academic and civic cultures communicate more continuously and more creatively with each other*” (1996, p. 20).

Beaulieu et al. (2018) conducted a scoping review of engaged scholarship publications, ultimately selecting 48 articles to summarize and conceptualize the engaged scholarship. Their findings reveal the principles on which the engaged scholarship works, consisting of: values (focused on social justice and citizenship, the recognition by researchers that they carry social accountability and civic responsibility to engage with the wider society), high quality scholarship, reciprocity (where the faculty needs to adopt reflective and iterative methods to maximize their impact – achieved through partnerships and collaboration), identification of community needs (finding and solving real societal problems), boundary crossing (involving a multi-inter-transdisciplinary approaches (Finkelstein, 2001)), and democratization of knowledge. The representation of findings is shown in Figure 1.

Recognizing that it is increasingly difficult for traditional education to equip students with 21st century skills, some scholars attempted to define closer the dimensions of engaged teaching. For example, Peterson (2009) has, similar to how we approached responsible education in (Culén & Karahasanović, 2022), considered how engaged scholarship applies to teaching and brings forward that there is a need to make a shift in pedagogy, values, methodology, community partnerships, and civic engagement.

The concept of **responsible education** is more recent and was first defined in 2007 in the context of the United Nations' initiative PRME¹ (Principles for Responsible Management Education). PRME was established to raise awareness around sustainability through alignment with business management education. It aimed to provide students with the knowledge and skills that would enable them to deliver change in the future. The six principles upon which responsible education rest are: the purpose, values, methods, research, partnership, and dialogue. Unpacking these principles shows similar ideas to those of engaged scholarship and can be seen in Boyer's vision seeking purpose and a larger mission, values, partnership, and collaboration between academic and civic cultures.



Figure 1: Engaged scholarship promotes values related to social justice and citizenship, engaging universities in finding solutions to social issues using quality, transdisciplinary scholarship. Adapted from (Beaulieu et al., 2018).

The term **transdisciplinarity** started gaining traction around the turn of the century and referred to managing complexity at the intersection of science, technology, and society where knowledge from a single discipline could not suffice to solve problems at hand and where the research work involved non-scientific, complex problems, such as poverty, health care, or access to education, sustainability. In this context, transdisciplinarity was understood as a form of learning and problem-solving through collaboration between society and academia to meet complex societal challenges (Klein et al., 2000). Scholz (2020) takes on to describe developments of transdisciplinarity and positions it as the critical element of the academic research mission. Furthermore, it explicitly connects practitioners' work and expertise with research rigor and sustainable development as a matter of real-world system transitions based on knowledge and social values (Scholz, 2020). There have also been suggestions offering teaching complexity as transdisciplinarity (Demerath & Suarez, 2019), describing how complexity studies can teach the benefits of transdisciplinarity and synthesize knowledge otherwise acquired through disciplinary actions studies. Again, there are similarities with the previous two movements (engaged and responsible education), such as the purpose (sustainable development and complex problem solving), values, partnerships, collaboration, and dialogue.

2.2 Interaction design and directions inspiring change in education

Technological opportunities have long been the driving force of innovation (Lindtner et al., 2014) in interaction design. Fascination with newer and better devices, but also how could new technologies be used to create more powerful experiences, modes of interacting, better interfaces, new platforms, and more has

¹ PRME <https://www.unprme.org/>

been persistent. At the same time, relatively little attention has been paid to when not to design something new, or how to design and innovate with focus on impact assessments on society, culture, and nature. Only lately, interaction design is evolving in the direction of responsible innovation. For example, Bates et al. argue that “*RI [responsible innovation] may benefit all innovators; it is an alternative lens that can be used to increase the positive impact of technological solutions and reduce the risk of unintended consequences challenging the success of the innovation in the future*” (2019, p. 3).

Although responsible research, innovation, and responsible education (Culén & Karahasanović, 2022) are still not widely discussed in interaction design, related directions are. For example, transdisciplinarity has been suggested as the foundation of the fourth paradigm of Human-Computer Interaction (HCI), where usability, cognitive modeling, and experiences represented dominant paradigms at different points in the history of the HCI evolution. Currently, design-led approaches play a central role in HCI. Thus, Blevis et al. (2015) suggest transdisciplinary design as the next design paradigm of interaction design education, scholarship, and practice. The transdisciplinary design education, it is suggested, needs to teach future interaction designers to bring a value orientation when designing digital artefacts, integrating it with design frameworks and focus on current challenges such as sustainability (Blevis, 2007; Blevis & Stolterman, 2009; DiSalvo et al., 2010), equity (Bardzell, 2010), values (Barreto et al., 2013; Iversen et al., 2010; Koepfler et al., 2014), justice and social responsibility (Bates et al., 2018), to provide just a few examples.

Another approach that aims to disrupt traditional education and its disciplinary divisions is STEAM (Yakman & Lee, 2012), a successor model of STEM (Science, Technology, Engineering, and Mathematics) education. The A in STEAM indicates the inclusion of arts and design in conjunction with STEM subjects and focuses on working with real-life problems through creativity and synthetic way of thinking as a transformative power needed to address complex socio-cultural problems for which science alone is not enough. So far, STEAM has been applied mostly in earlier education, but there have been efforts to include it at the university level, also in interaction design education (Babaci-Wilhite, 2019; Culén & Gasparini, 2019).

2.3 Transition design and design education

One of the essential development areas of transition design is education. From the School of Design at Carnegie Mellon where TD² was conceived and where the first educational program in Transition Design (TD), a Ph.D. program, was implemented and is currently running, the approach has spread across the globe. Many universities and schools of design offer courses or programs in transition design.

There is a clear overlap between TD and responsible research and innovation, sustainable design, responsible HCI, and other directions that advocate a holistic look at the present challenges and advocate more radical changes in education. Many educators see the need to provide education that is better suited to meet the challenges and prepare students to create and implement more desirable futures than the ones that we might have should we continue along the trajectory that we currently follow.

Transition design is perhaps the newest and perhaps the most encompassing approach that embraces a radically different way of thinking. Having a philosophical grounding in ontological design, orientation towards the future and how this future can be socially embedded, the explicit inclusion of values, ecological thinking, systemic thinking, and transdisciplinarity, it offers exciting educational opportunities. The four-component transition design framework proposed by Irwin et al. (2015), see Figure 2, is also an excellent tool to help transition design education work with complexity. The first component of the framework invites designers to examine their *posture and mindset* concerning the situated work context. The second component, *the theories of change*, suggests considering diverse (primarily social but also economic and other theories such as social practice theory, nudging, or pressure points) theories that might be utilized to initiate the change at scale. The third component reflects the need for finding desirable *visions for transition*, where the design team uses various means to generate alternative visions of the future and use them to discuss challenges, opportunities, and possible consequences. Lockton and Candy (2018) describe the initial vocabulary and methods to do so, such as futuring, backcasting, imaginaries, and foresight practices that might be used to create visions. Finally, *new ways of designing* address the changes in design practice that

² <https://design.cmu.edu/content/phd>

required to tackle the complexity of problems. They imply seeking entirely new approaches to design or integration of existing ways of designing, making them into more powerful tools.

Since the educational program was established at Carnegie Mellon, the school has also contributed with some publications concerning how to apply the framework to design education (Irwin et al., 2020; Rohrbach & Steenson, 2019). The international network of universities and programs featuring transition design courses is growing. Researchers describe TD's implementation at the Politecnico di Milano (Bisson et al., 2022), University of Oslo (Culén & Karahasanović, 2022), Delft University of Technology, among others. Thus, the experiences from teaching, pedagogies, and other lessons from implementing transition design courses are being developed and provide a high level of activity toward creating more appropriate education capable of tackling wicked problems better.

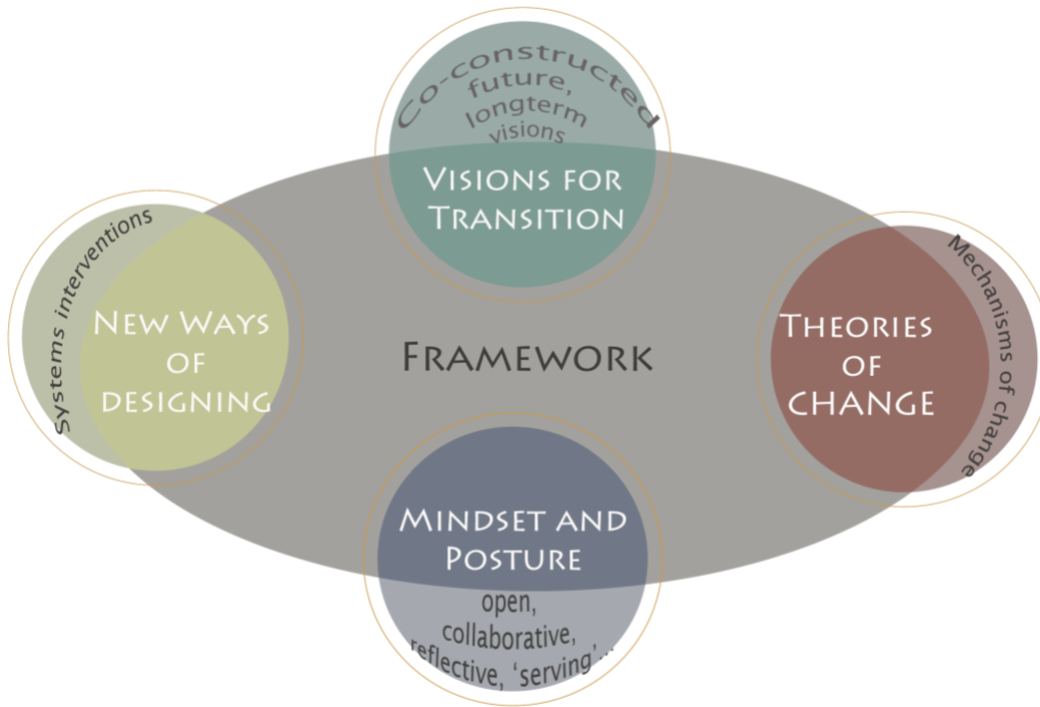


Figure 2: The four-component transition design framework adopted from (Irwin et al., 2015) is used as a teaching tool and as a design tool. Reflecting on its components in relation to each project helps better understand its use.

3 Context and methods for working with the course

This section first describes the course in transition design that we teach, followed by the teaching strategies that we aim to implement.

3.1 The course in Transition Design at the University of Oslo

The course that we teach was conceptualized in 2018 and started running in 2020. Prior to 2018, two of the authors taught a project-based course in interaction design, in collaboration and partnership with organizations from the private and public sectors or large research projects. While teaching, we also explored how to incorporate a value orientation into interaction design education. The inquiry approach was research through design, where we sought to design our teaching practice. We worked with systematic, iterative improvements based on our reflections and data collected from students, partners and other stakeholders aiming to integrate the principles of responsible education and move the course toward responsible interaction design. For a detailed description of our approach, see (Culén & Karahasanović, 2022). After several iterations and many changes in how and what we taught, we felt the need to create a new course, an elective, which became the transition design course that is currently in its third run – and iteration concerning our teaching practices and conceptualization of what we teach and why.

The TD course is offered in the last semester of bachelor's studies in the study program Design, Use, and Interaction at the Department of Computer Science at the University of Oslo. It is a lot smaller than the interaction design course, which was an obligatory one. Since the students are not obliged to take the TD course, but chose to do so, they are often better motivated from the start to engage with the subject. The transition design course has had, on average, 17 students, implying 4-6 projects per year, which continue to be run in partnership with external collaborators and focus on current, real-life problems.

3.2 Teaching strategies

Since TD is novel for our students, they need an initial understanding of what the approach entails and how it differs from what they already know. Our basic teaching strategies rest on a combination of

- 1) a *'spiral' model* for communicating state of the art on **knowledge about transition design**, based on previous research and published work,
- 2) design practice that requires **teamwork** – preferably **across disciplinary boundaries**,
- 3) facilitating knowledge construction through the entanglement of concrete **design experiences based on real-life projects with external partnerships** and abstract thinking related to transition design and ideas and theories it stands on, and
- 4) **complexity** – **shifting perspectives and scales**, using ambiguity and uncertainty, scrutiny through discussions and debates.

We expand a bit on each one of these.

Concerning the knowledge about transition design, we have been following the foundational ideas TD stands for and considering how to make students understand them most efficiently. Before taking the course, the students did not have many opportunities to contemplate relations between economic systems, politics, social structures and what this might have to do with technology design. In other words, the perspective is a lot larger than is common for the courses they had. On the other hand, the students have gained a solid background in interaction design, use of interactive artefacts, and participatory design. To make the new approaches accessible fast, we use the lecture format in combination with design reflections (crits). Over the past three years, we used a somewhat different set of publications as a course curriculum, with variation in both selection of articles and the number of them. The following articles, though, have represented the core of the curriculum (Gaziulusoy & Oztekin, 2018; Irwin, 2018; Kossoff, 2015; Lockton & Candy, 2018; Tonkinwise, 2015). The books (Capra & Luisi, 2014; Escobar, 2018) are not obligatory readings but are used to explain transition design's philosophical and ontological positioning. However, the lectures are not delivered entirely traditionally – we follow a 'spiral' model that we arrived at by experimentation on how to impart this new knowledge effectively. The model suggests visiting the same core material several times. Typically, the first time communicating just the core notions at high speed, we offer a more solid presentation later. Finally, after gaining practical experience through multiple design projects, a plenary discussion on articles takes place. The students are expected to reflect on the curriculum and embody the new knowledge in the artefacts they make. We follow this process through design crits, where all teams present their progress and thoughts on what they are working with and relate it to the curriculum.

2) We focused on teamwork as a collaborative effort to effectively and efficiently reach the desired project goals. While the students constitute the core design team, for the learning in this course, anyone who could help move the project forward is welcomed to join the team and share their knowledge or skills, helping the students see how to break disciplinary boundaries. Each student team was expected to approach their design context in collaboration with a partnering organization but could look beyond for additional stakeholders that their project involves.

3) The learning model that we implemented is based on the constructivist and experiential learning models such as (Beckman & Barry, 2007; Kolb, 1983), where that the learning unfolds through reflection and knowledge construction building on past experiences and constructivism. For example, Kolb's model describes that learning happens when knowledge is created through the transformation of experience. This transformation happens by combining concrete experiences (action, doing) with abstract conceptualizations (thinking) by reflective observations and active experimentation. This learning model fits well with the design research processes, where the design researcher moves on a trajectory between three main activity areas: design studies, design experimentation, and design practice (Fallman, 2008). Students create and follow their

own trajectories through those activity areas and articulate their process during design reflections. We offer help when it is needed, but students make decisions concerning the collaborative design with partner organizations.

4) Teaching design that involves complexity and systemic perspective provides a unique opportunity for showing students the value of broad problem framing and the ability to discover the right approach towards finding a solution that makes improvements within the framed context. At the same time, the large scales at which solutions are offered are sometimes so large that they feel uncomfortable, impossible, or confusing. Therefore, we believe it is OK to work at different scales and with shifting perspectives, following Irwin et al. (2020) and Cody's (2017) depiction across dimensions of expertise and the scale of engagement as shown in Figure 3.

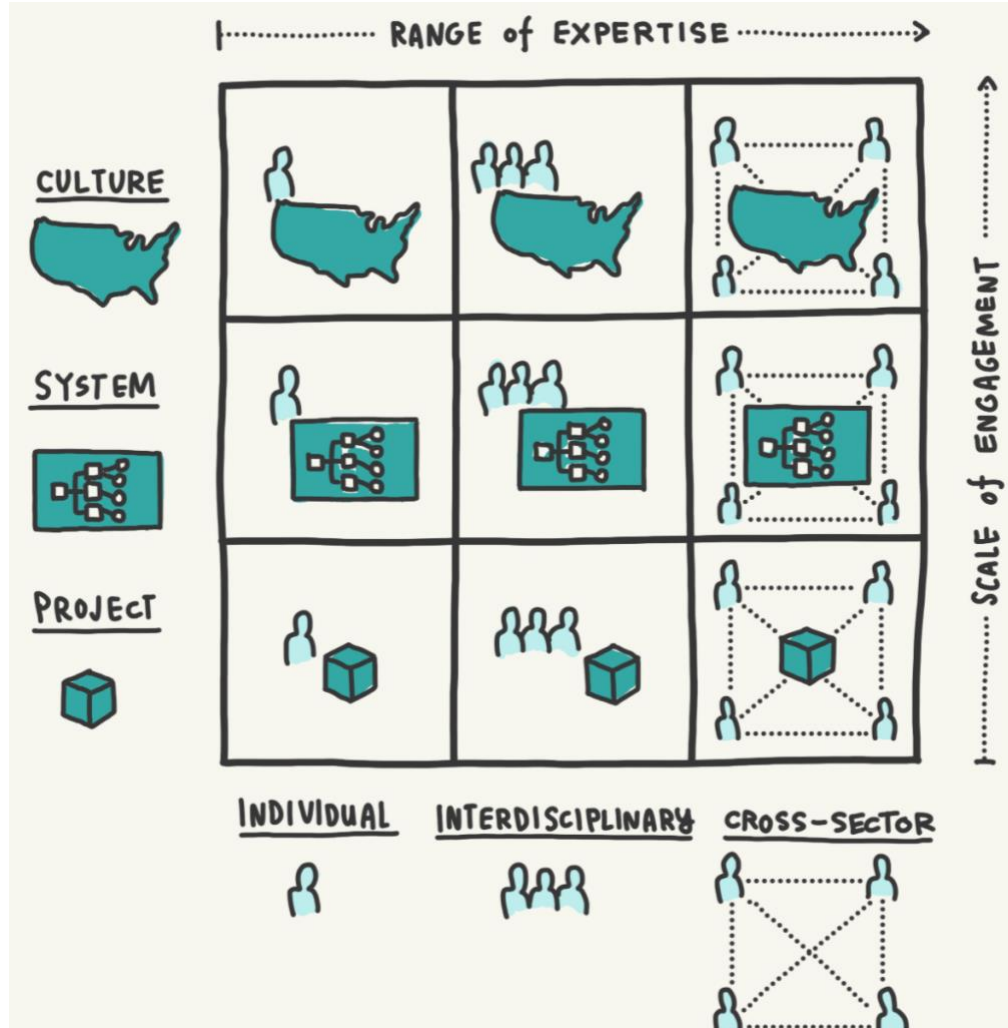


Figure 3: Social design pathways across scales of engagement and range of expertise from (Cody, 2017).

4 Projects and partnerships

Given the novelty of transition design, we aimed to impart particular aspects of transition design that we thought differed from what students were familiar with. First, *time and temporal* aspects of design were more important and especially being able to grasp the impact of designs within a particular situated design context. Next, we wanted students to learn how to consider their design contexts from *multiple perspectives* as the bases for their *teamwork* and contemplate *the purpose* of their project – which is known to be a critical factor that influences teamwork (Whelton, 2004). *Engagement* – included interactions with other actors related to the project, focusing on communication, deliberations, and dialogue (Krippendorff, 2005; True et al., 2013).

We aimed to explain *ontological design's* challenge to grasp that all designed objects, tools, or services bring about particular ways of being, knowing, and doing, i.e., we design artefacts and they 'design' us in return – there is a mutual shaping between designs and humans using them. *Ecological thinking* – a recognition that humans are not separate from nature, is also important in the context of transitions, as is *systems thinking* – integrating a more holistic perspective on the design of new technologies. *Future-orientation* of transition design – taking a look at what is desirable in a long term, is also novel and, as discussed later, often challenging to grasp for the students.

To set in practice these new ways of thinking, the students need to master *research approaches and methods*. As for the research approach, we introduce the TD framework, not as a prescriptive way forward, but as areas to focus on and consider when trying to make sense of the design contexts. Another chapter of the book is dedicated to research methods – these are carefully introduced through multiple workshops with students. So, they learn many ways of doing, and through reflection on their own project, they need to select the most appropriate methods to work with visions, values and impacts.

Besides offering explanations and reflections on transition design and how to go about implementing it, from our side, one of the most important tasks is the selection of partnerships and projects that are diverse and can be implemented at different scales of engagement and expertise, Figure 3. The diversity of projects supports learning across different teams, by discussing how each team tackles various aspects of transition design. Each year the course was offered, we have selected a theme that the projects addressed. The first year, the topic for projects was machine learning and sustainability, the second year the theme was grassroot design and the power of small, local communities to affect larger scale transitions toward sustainable futures. This year, the third run of the course explores the role of culture and cultural institutions in transitions toward more desirable futures.

To explain this process and our thinking about possible design contexts, we briefly discuss the selections of partnerships for this year.

1) The **RELINK** project was offered to the students in collaboration with Oslo Metropolitan University as part of a larger research project looking at how personal behaviors and infrastructures combine to influence personal data security in smart home ecosystems and how they might be reconfigured to create more digitally literate and resilient households. This project provided an opportunity to look at the balance between technology solutions and their positive and negative societal impact. In order for students to work in this area they would need to investigate the wide and ever-increasing range of technologies that might be included in the project while also trying to uncover the effects of these technologies.

This was seen as a suitable project for a number of reasons. The existing critical framing of technology within the project allowed the students to also then present proposals which might critique current infrastructures much more freely than they otherwise might in a typical commercial design brief. This critical framing might also encourage the students to observe the ever present, detrimental aspects of technology implementations which are typically overlooked or minimized. But conversely the project also explicitly dealt with leading edge technologies which are obviously highly relevant to interaction design students, society, and transitions.

2) Nordic International Support (**NIS**) Foundation, which usually provides support internationally, collaborates with students on two projects. The aim with this collaboration with our course was to explore how Norwegian youth relates to issues of sustainability, and how can one increase their knowledge and interest around the topic. This learning and information sharing is to happen through cultural institutions like libraries and museums, and in a social context. The projects seek to engage the youth in critical thinking through interactive installations designed for use in cultural institutions.

The projects were seen as quite suitable for the students, as they allowed students to build on their previously acquired interaction design skills. However, in this course, they gained the opportunity to think in terms of scaling of their design and how it might help achieve longer and broader engagement with youth. Thus, the design teams need to think in terms of after-design, and how to make their installations tailorable to multiple uses, perhaps with repeated visitors. Thus, it might be desirable to work to progressively strengthen the information and awareness of unsustainable behaviors among youth and allow them to imagine alternative, more sustainable future(s).

3) **Oslo Barnemuseum** (Oslo Children's Museum) also collaborates with two student teams. Over the last decade, an increasing number of student teams in interaction design course, and now transition design, has

engaged in working with the children's museum on more serious topic that aim to include also children in understanding and dealing with more complex topics, like climate change, loss of biodiversity, civic engagement, see (Culén & Katie Coughlin, 2022). The design is situated in the context of family-oriented events that the museum organizes called CityKids.

These projects, similar to the NIS ones, offer students an opportunity to build new skills and understandings of transition design by expanding their knowledge of interaction design and integrating reflections on their vision for the future and how their projects fit into that vision, how the events like CityKids might come to transform cultural norms on how children should be protected completely (overprotected) towards including children in more serious dialogues on current challenges, from planetary to social, and help them build as early as possible pre-cursors for critical thinking by, for example, recognizing good options among several alternatives.

4) The accessible tourism for inclusion and value creation in rural areas, **ACCESSTOUR** project, was offered to students in collaboration with SINTEF. It is a part of a larger, three-years research project aiming to develop knowledge on building sustainable and accessible rural local communities and nature-based tourism destinations, through stakeholder collaboration in a regional multi-stakeholder network³. The project recognises the potential for value creation in accessible tourism (AT) in Norway. AT may give access to new markets and new customer groups including elderly retired people and local citizens. AT can also support the operationalisation of UN sustainable development goals. The student project contributes to the overall goal by designing solutions of the future that make tourist attractions accessible to the elderly through information and experience sharing.

The project has been suitable for this course due to several reasons. A multi-stakeholder network including both businesses and interest organisations within tourism, interest groups and research institutes was already in place giving students easy access needed resources. Further, the project has clear 'think globally – act locally' strategy aiming to answer global challenges in the context of rural Norway. The potential impact of the students' work on the local community practices will be visible within the timeframe of the student project. While exploring the space of possible novel design solutions the students will apply and further extend their knowledge on interaction design and universal design. At the same time, they will learn to think in the categories of social, economic and environmental sustainability and how to deal with wicked problems within the limitations of a one-semester long project.

5 Teaching/learning practices

How to deliver on our teaching strategies and the knowledge that we wish to communicate is a matter of adjustments as a consequence of being reflexive practitioners in design of our teaching practice, ongoing as we teach (reflection in action) and adjustments after each semester of teaching ends and before the new one starts (reflections on action) (Schön, 1983). Based on these reflections, we extracted the list of elements that we can use to support emerging teaching protopractices until we find the ways of teaching that gives desired learning outcomes. These elements include: **time and temporality** – where multiple dimensions were considered, from tuning the timing of lectures with design practices to future-oriented aspects of transition design; **teamwork** – focusing on efficient and effective collaboration and partnership; **purpose** – having a purpose is known to be a critical factor that influences teamwork (Whelton, 2004); **engagement** – included interactions with instructional team and other actors, engagement with the project and its purpose, deliberations and dialogue (Krippendorff, 2005; True et al., 2013); **partner and project selection** – this was described in the Section 4 for the current run of the course, similar considerations are taken every year, in conjunction with the selection of the new theme for the course and design; **mastery of research approaches and methods** – supporting the use of methods and methodologies that the students are familiar with in combination with learning new methods and understanding the framework (Figure 2) better, which are described closer below; **ontological design** – a challenge to think of design as being ontological in the sense of understanding that the designing our environment and objects that we use also shapes us, that is, all designed artefacts bring about particular ways of being, knowing, and doing; **ecological thinking** – a

³ <https://www.nordlandsforskning.no/nb/accesstour>

recognition that humans are not separate from nature; *systems thinking* – integrating a more holistic perspective on the design of new technologies, and *future-oriented design* (visioning) – taking a look at what is desirable in a long term when considering the design of new technologies; *values* – both values on which design rests, but also the personal values and those of the team.

Working with these elements co-constructs our pedagogical approaches. For example, this year, upon reflecting on the outcomes from the previous year, we decided to introduce changes in the way we deliver the teaching. The challenge that we have identified was that if methods and methodologies for transition design come later in the semester, students already start thinking and designing based on what they knew from before. Thus, instead, this year we started with a brief introduction to transition design, followed by two sessions of workshops that presented new, transition design methods that are better suited for imagining the desirable future and allow for more systemic thinking. Each student team had to organize a short workshop (up to 30 minutes long, using one of the methods for futuring such as the three horizons, future wheels, things from the future and others). This activity implied that they had to learn about the method (flipped classroom approach), pilot the workshop, figure out materials that they needed to engage other students with the chosen method (things to think with, canvases, cards, and more). The other teams then had to apply the method to their own projects, which helped orient their work towards visioning and thinking about desirable futures from the very start of the course.

Subsequently, we presented how we see the context for the project work and ways in which projects are suitable for transition design approach, followed by four 2-hour lectures aimed to better clarify each component of the transition design framework. Only then we focused on more theoretical and philosophical aspects of the course such as discussing the ontological approach (Capra & Luisi, 2014; Escobar, 2018; Irwin, 2018), holism and everyday life as a design context (Kossoff, 2015).

Notably, we implemented design crits as the method to run on a weekly basis, where each team presents the progress from the last week and everyone in the course can make comments or suggestions, intended to help the work move forward appropriately. Further, the intent with this is to have the opportunity to closely follow each project and its development, learning not only from own project, but from all of them. As the projects are intentionally chosen to be quite diverse, there are many learning opportunities that present themselves, perhaps first and foremost considering the engagement and scaling, as described in Figure 3.

Also, on a weekly basis, each student team had the opportunity to meet with one faculty member who is assigned to the specific project based on the faculty's knowledge and interest, to discuss the project. The teams are also encouraged to discuss their projects with partners, but there were no specific requirements given in terms of how often or how much they should engage the partners. Thus, while all teams did involve partners, the level and kind of involvement differed from team to team.

6 Discussion

In the next section, we first discuss the positioning of transition design as part of interaction design education, and then some more concrete challenges and opportunities with teaching transition design, based on our experiences with selecting the projects and teaching the course over the last three years.

6.1 Transitioning to a new educational paradigm?

As discussed in the first two sections of this chapter, to make transition to sustainable lifestyles, we need to make a paradigm shift in design education. From the description of important elements that we want to convey through the course and the way we select partnerships, it should be easy to see that values and social benefits are central, and that engaged scholarship is a part of what we aim to do through the course. Furthermore, the focus on the six principles of responsible education should also be easy to recognize: the projects have a purpose, build on values, include partnership, research methods and methodologies, and dialogues shape both thinking and making. Thus, transition design subsumes both engaged scholarship and responsible education. While it is difficult in the classroom setting to work in a truly transdisciplinary setting, the partnerships provide alternative perspectives, often from other disciplines.

The power of transition design, we believe, is in its focus on desirable futures, on the power of design and designers to change their focus and work towards better, more desirable futures for humanity and for our

planet – currently the only one we have and share. Although in next subsections we describe some possible and even likely pitfalls with shifting the paradigm of design education to ontological, holistic one, we believe that such a shift is necessary. While we might not yet be best equipped for this challenge, it seems to be a very strong option at this time. Thus, we cautiously move forward, while trying to mitigate challenges.

6.2 Recognizing important aspects of transition design projects

Addressing challenges, we first reflect on how supplying students with ‘real’ projects and stakeholders allows students to learn and practice a number of the design aspects typically introduced in the context of a transition design course. We note that if the projects themselves are not appropriate or the method of approach is not followed up suitably then it can be very easy for students can fall back on previously learnt methodologies and approaches. This can mean that the differences in approach between transition design and other approach such as user centered design might not be clearly outlined. This confusion can be determinantal as not only has the transition design approach not been learnt but it is now possible confused with these other approaches.

For these reasons, the criteria of the projects on offer needs to be carefully considered. In addition, the stakeholders, collaborators, and their aims also need to be considered as they perform an integral and vital role in the learning process. The following are characteristics we have found that need to be considered when selecting suitable projects.

- 1) Open project areas. The projects should be open in nature and not have a very specifically detailed outline of what is required. This allows the students to explore and map the area and develop their own directions for the project in collaboration with other stakeholders in the project.
- 2) Open and available collaborators. Secondly the collaborators initiating the project need to be open to this more explorative and collaborative way of working, rather than expecting to be able to supply students with a strict set of design criteria for a predefined and expected output. Ideally these collaborators and other stakeholders are available, and open to participate in mapping and workshop sessions which give the students valuable experience running these workshop scenarios but also obviously provide the students valuable input to the actual project.
- 3) Sufficient size and scope of projects. Of sufficient size and scope that the small groups can make some head way in the time period but need to put in sufficient work to do so. (that work might be spent in figuring out how to tie their concept to the large transition of society . But conversely not too large that they cannot complete it or believe that they can complete it.
- 4) Contain a practical element. Although this is not a necessary criterion, it is beneficial for interaction design students as it allows them to utilize a number of their existing skills on the project and therefore feel some form of contribution rather than simply detailing a largely conceptual project in which it can be difficult to feel and ascertain their involvement.

6.3 Experiences with teaching the transition design course

Over the three years of teaching this course, it has become apparent, that there are certain recurring difficulties that many students face when learning transition design and then trying to implement that learning for the first time. Many of these difficulties stem from the larger scales of complexity, time and considerations involved in these projects than in other typical projects they have faced during their studies. Others arise from the fact that they cannot use their traditional skillsets to tackle these issues at the very time in which things become more complex. These issues can make it difficult for students to see the relevance of the framework which can result in a lack of motivation, participation, and learning.

One technique that we have found successful at relieving some of these difficulties is the use of smaller, more familiar concrete design projects that the students tackle as part of their learning and in which they can enact their newfound skill and techniques.

The following sub-sections outline some of these common or recurring tendencies or difficulties that students face in the transition design course. The observation of some of these tendencies has led to the focus on some of the teaching elements outlined earlier in the early section.

6.3.1 Seeing no direct connection (systems thinking)

The adoption of a more holistic, *systemic approach* to the project area is often a significant departure from their typical approach to a design task. Often, they understand the need for transition design, they may even understand the framework itself but struggle to see how it might work with their preconceived ideas of their future careers and the projects they might work on. Several of the prominent case studies such as, the Ojai water project which seek to illustrate the working of the framework can make the relevance of the framework even more unclear as they bear little relation to the aspects these students are familiar with. The type of project (with no commercial actors, instead a collection of stakeholders), the resources (multiday offsite workshops) and issues involved are far removed from their likely future jobs in design and tech consultancies in Europe.

Additionally, there is a common misconception among the students studying interaction design, that as this does not directly deal with the design and manufacture of plastic goods, or the exploitative conditions in a garment factory, they are not part of the problem and therefore do not need to concern themselves. Taken further, there is often an argument put forward that as they are dealing with technologies that they are in fact automatically part of the solution rather than the problem.

The inclusion of systems-oriented design content, giga-mapping (Sevaldson, 2011) and leverage points (Meadows, 1999) within the course has been an attempt to address this perceived lack of connection between the large societal problems the students own work or influence. Furthermore, working on projects that are representative of the sort they could conceive working on in their future career brings the connections much closer. It allows them to understand how their design choices and implementations can in fact have great significance and far-reaching consequences. Further, all their learnings are much more relevant, on a location basis, on a sectoral basis and on a skills basis. They also gain an understanding of the difficulties and possible benefits of these relevant sorts of projects. In addition, it also helps build networks of likeminded practitioners and enablers which can be of subsequent use in their careers.

6.3.2 Feeling overwhelmed (ontological approach)

Subsequently pointing out, the very professions they are about to enter, can and do have extremely detrimental outcomes in often results in some student feeling slightly despairing or overwhelmed, thinking they must now resolve all these issues. Others seem to withdraw in the belief that NOT contributing is the least bad option. Others take a more defiant tone and point out that lots of other projects, startups and technologies do it in this way and have always done so. None of these emotional states is one in which the student is empowered and can eagerly explore the area, making positive changes and connections.

Rather than countering the feeling of being overwhelmed by removing themselves from the field, having them work on a real, project in their field and see ways in which it can then instigate, implement or ferment change and further amplify this change by linking to other existing but like-minded projects can be quite empowering. Rather than see themselves going into a profession of problems and concerns, they are more open to seeing a field of possibilities and potential. This comprehension of the sometimes subtle but powerful ways in which design can and does affect people helps to illustrate the *ontological* effects of technology implementations. Along with the systemic approach, the students might be better placed to consider some of the second or subsequent order effects of their designs

6.3.3 Unease when working without a clear direction (purpose/value)

The direction in which a design project proceeds can be provided by a number of inputs. Clients, user research, new technology platforms and competitors can all provide this directional input. In larger, more systemic issues or project areas none of these are much use in suggesting a way to navigate. Having a defined sense of *purpose* and an outlined *value* can also provide a method of navigating through a project. An example of this can be seen in Dune and Raby's A/B manifesto (Dunne & Raby, 2013). But this is not generally exercised in a 'typical' design approach. In fact, designers are often expected to emotionally remove themselves from the design process as it should be 'user' focused. Subsequently, often it becomes apparent that the skills they have previously utilized in order to develop and iterate concepts, might not be suitable or capable of dealing with the scale or complexity of the issues involved in their projects. It no longer makes sense to iterate or do user testing on which button combination works better when the actual issues are how to make users aware of the privacy issues involved in their smart home devices. With this realization, students often, understandably, are very cautious of proceeding without a clear method for identifying a direction

forward. Additionally, they often feel very anxious as they don't have familiar reference points to help identify their progress. In order to have some 'knowns' in their project students often try applying previously used but inappropriate methods. This tendency is covered in the subsequent paragraphs. As mentioned, having a very clear and defined sense of purpose (beyond grades) and an understanding what the group wishes to achieve with the project (but not necessarily how to best achieve it) can be useful here. This purpose can help navigate through this uncertain period. For those groups lacking a clear sensor of purpose, this is often the period in which this starts to come into focus.

6.3.4 Resorting to known methods (mastery of research approaches and methods)

With so many new aspects to absorb and a much greater range of considerations than in 'typical' projects, students tend to refer to known techniques or methods. This is completely understandable and provides them an opportunity to illustrate some form of *mastery* of methods. It also allows for the retention of some 'knowns' while many other aspects are either new, unknown or uncovered. Many skills for idea generations, group facilitation, workshop organization are very suitable. However, many methods and techniques are not as useful as they might be in small more defined projects. Generally included in the student's repertoire of skill is some form of user centered design method. The method is well known and extremely attractive as it provides clear, articulated steps. But much of this clarity stems from the fact that it fails to account for large sections of the issues hand. Lack of consideration of materials, environment, society, etc. Applying this methodology early in the process extremely restricts the focus and considerations of the students. Once students have started applying this methodology and made some process it becomes difficult to get them 'to un-think' their concepts in order to broaden their realm of considerations.

For similar reasons, it can be difficult to introduce a number of concepts/frameworks/ methods at one time in order for students to implement them into their projects. The methods will naturally demonstrate a range of difficulties, in their conceptual nature and in their difficulty to implement into a project. If this range of difficult is significant then it is likely that students tend to select those easiest to conceptualize or implement. To counteract this tendency, as mentioned in a previous section we have attempted to give students the opportunity to learn and quickly familiarize themselves with a number of new skills and techniques through a workshop session in which they teach each other various new techniques. Each of the group 'learning' the technique uses their own project as the subject material. They then gain a rapid introduction to multiple new techniques, some firsthand experience in implementing them and an understanding of their utility. In addition, they hopefully have multiple new directions or ideas to explore in relation to their own projects.

6.3.5 Desire to rapidly develop a concept (value)

Another common tendency utilised in order to establish some known references points is for students to try and select a concept very early in the process. This tendency is increased when there are other groups on different projects who seem to have 'advanced' further. This results in similar outcomes to the previous tendency. This premature selection of a concept often means that the direction chosen is very simplistic and tends to follow predictable directions that lack acknowledgment of a large number of aspects that pertain to the project area. Groups with a strong *values* seem to be less susceptible to this pitfall.

6.3.6 Insufficiently able to develop realistic, but broad reaching visions (future oriented visions)

An alternate and contrasting method to deal with the complexity of projects is that students then devise a simplistic, but high level, abstract often future oriented concept that often relies on contestable assumptions and claims to resolve multiple deep seated society issues. This illustrates the lack of experience in developing future oriented concepts that are sufficiently 'grounded' so that they might be adopted into everyday lives. Discussion about speculative design work, methods of visioning (Lockton & Candy, 2018) combined with discussion about Koshoff view of 'everyday life' (Kossoff, 2015) and Max-Neef et al. theory of needs (Max-Neef et al., 1992) aims to provide students ways and means to anchor these concepts to relatable and accessible entry points. Having students working on very concrete projects immediately brings them back to realistic concept's and they can then face their assumptions more directly in order to be more frank about the impact their project might have.

6.3.7 Difficulties working with long timeframes (time and temporality)

The aspect of time, temporality and long timeframes in particular is tackled in a more graduated approach. Because the students' projects are concrete and real, they have an identifiable timeframe to which some sort

of project plan can be scheduled. However, in addition, the students can consider how this project might continue, develop or evolve or become redundant over a longer period of time.

6.3.8 Lack of experience in considering concepts as part of an ecosystem (shifting scales, levels of engagement)

A notable difference in transition design projects from typical commercial design briefs is that of scale and complexity. Because the issues that transition projects aim to tackle are complex and multifaceted, the project outcomes are also often similarly complex and multifaceted, involving multiple scales, partners, timeframes, locations, infrastructures etc. This is understandably overwhelming for students especially if considered from a typical design point of view in which the outcome should be seamless, unified and consistent across all these scales, timeframes and infrastructures. The more involved and organic development of transition projects means the designers role is more strategic and conceptual rather than being intricately involved in the details of each and every interaction. This first requires students to recognize this difference in approach. Secondly, they need to develop new skills in understanding how they might shape this organic, iterative growth. Thirdly rather than detailing each aspect or interaction they might utilize existing, aligned initiatives and through working together achieve mutually beneficial outcomes that amplify and strengthen all the initiatives involved.

While defiantly not easy, this third skill of linking projects and initiatives in order to ‘scale across’ can be seen as ways of moving both across and toward the upper right quadrant of the Winterhouse social pathways matrix, Figure 3.

6.3.9 Tendency to value novelty or ‘innovation’ over appropriateness (systems thinking)

With the technical nature of interaction design curriculums and common inclinations of the interaction design students, most projects during their education tend to focus on the implementation, use and adoption of new digital technologies.

In addition, when design in general is discussed, publicized or promoted in the media there is nearly universal description of it as being ‘innovative’ and cutting edge. These two intertwined aspects mean that students initial directions also involve the heavy use of technology in an attempt to resolve issues. Conversely there is little attention paid to interesting, grassroots initiatives that show potential as they are not ‘new’ or do not fulfil the classic descriptions of innovation. This is problematic in multiple ways. Firstly, students tend to underestimate the requirements, the costs and the timeframes required to implement their technology heavy concepts. They also tend to heavily overestimate the general appeal and community uptake of their concept students. Conversely, they overlook the passion and resources already involved in existing initiatives. Both these aspects can be mitigated by aligning their concepts with existing initiatives and possibly using technology more incisively to help amplifying these aligned initiatives.

7 Summary

Design as a profession and an academic discipline is increasingly recognized as a contributor to grand challenges of our time, for example, overconsumption with its implications on the environment on the one hand, and as a powerful force toward finding solutions to complex problems of today. For design and designers to continue contributing positively, addressing and changing design education is also necessary. Fifteen years ago, United Nations suggested a concept of responsible management education, focusing on six principles entailing partnerships, purpose, research, methods, values, and dialogue. These principles also apply to design education.

Furthermore, there is a growing recognition that science alone cannot resolve the challenging, complex issues that are not scientific in their nature, such as poverty or social justice. Thus, more generally, transdisciplinary approaches to design and problem-solving have emerged, e.g., engaged scholarship and responsible education. The transdisciplinary design has been proposed as the fourth design paradigm of interaction design education, scholarship, and practice. The transition design is the latest transdisciplinary proposal, and likely the most comprehensive one, to transition design education to a different position - the one that might help to create desirable, sustainable, and equitable futures. While the proposal is promising, it comes with challenges concerning teaching practices and finding novel pedagogical approaches that provide a good learning environment for students. This chapter discussed our approach to teaching a newly established

course in Transition Design at the University of Oslo that is currently in its third run. We pointed to the range of opportunities and challenges that we have experienced, particularly concerning the shift in thinking and accepting a different paradigm and a different point of view on design and designing.

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REFERENCES

- Babaci-Wilhite, Z. (Ed.). (2019). *Promoting Language and STEAM as Human Rights in Education: Science, Technology, Engineering, Arts and Mathematics*. Springer Singapore. [//www.springer.com/gp/book/9789811328794](http://www.springer.com/gp/book/9789811328794)
- Bardzell, S. (2010). Feminist HCI: Taking Stock and Outlining an Agenda for Design. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1301–1310. <https://doi.org/10.1145/1753326.1753521>
- Barreto, M., Scott, M., Oakley, I., Karapanos, E., Nunes, N. J., Gomes, S., & Gomes, J. (2013). Playing for the Planet: Designing Toys That Foster Sustainable Values. *Proceedings of the 31st European Conference on Cognitive Ergonomics*, 16:1-16:6. <https://doi.org/10.1145/2501907.2501947>
- Bates, O., New, K., Mitchell-Finnigan, S., Mauriello, M. L., Remy, C., Bendor, R., Mann, S., Chopra, S., Clear, A. K., & Preist, C. (2019). Towards a Responsible Innovation Agenda for HCI. *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–8. <https://doi.org/10.1145/3290607.3299017>
- Bates, O., Thomas, V., Remy, C., Friday, A., Nathan, L., Hazas, M., & Mann, S. (2018). Championing environmental and social justice: Embracing, embedding, and

- promoting broader notions of sustainability in HCI. *Interactions*, 25(5), 60–67. <https://doi.org/10.1145/3236677>
- Beaulieu, M., Breton, M., & Brousselle, A. (2018). Conceptualizing 20 years of engaged scholarship: A scoping review. *PLOS ONE*, 13(2), e0193201. <https://doi.org/10.1371/journal.pone.0193201>
- Beckman, S. L., & Barry, M. (2007). Innovation as a learning process: Embedding design thinking. *California Management Review*, 50(1), 25–56.
- Bisson, M., Palmieri, S., Ianniello, A., Botta, L., & Palomba, R. (2022). Transition design: An Opportunity for Design and Designers. *INTED2022 Proceedings*, 2692–2702.
- Blevis, E. (2007). Sustainable Interaction Design: Invention & Disposal, Renewal & Reuse. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 503–512. <https://doi.org/10.1145/1240624.1240705>
- Blevis, E., Koskinen, I. K., Lee, K.-P., Bødker, S., Chen, L.-L., Lim, Y., Wei, H., & Wakkary, R. (2015). Transdisciplinary Interaction Design in Design Education. *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems*, 833–838. <https://doi.org/10.1145/2702613.2724726>
- Blevis, E., & Stolterman, E. (2009). FEATURE: Transcending Disciplinary Boundaries in Interaction Design. *Interactions*, 16(5), 48–51. <https://doi.org/10.1145/1572626.1572636>
- Boyer, E. L. (1996). The scholarship of engagement. *Bulletin of the American Academy of Arts and Sciences*, 49(7), 18–33.

- Capra, F., & Luisi, P. L. (2014). *The systems view of life: A unifying vision*. Cambridge University Press.
- Cody, L. (2017, March 22). Intro to Design for Social Innovation. *Medium*.
<https://medium.com/@leacody/design-for-social-innovation-b2cfd49790de>
- Culén, A. L., & Gasparini, A. A. (2019). STEAM Education: Why Learn Design Thinking? In Z. Babaci-Wilhite (Ed.), *Promoting Language and STEAM as Human Rights in Education: Science, Technology, Engineering, Arts and Mathematics* (pp. 91–108). Springer Singapore.
https://doi.org/10.1007/978-981-13-2880-0_6
- Culén, A. L., & Katie Coughlin. (2022). Growing Up in a Complex World: Engaging Children in Socio-Cultural Matters Through Speculative Installations. *Proceedings of the 2022 ACM on Designing Interactive Systems Conference*, 1633–1645. <https://doi.org/10.1145/>
- Culén, Alma Leora & Karahasanović, Amela. (2022). Towards Responsible Interaction Design Education. *DRS 2022*. DRS2022, Bilbao, June 2022.
<https://doi.org/10.21606/drs.2022.465>
- Culén, Alma Leora & Stevens, Nicholas Sebastian. (2022). Speculative and Critical Approach to Designing Technological Futures through HCI Education. *Interaction Design and Architecture(s) Journal*, 51.
- Demerath, L., & Suarez, E. D. (2019). Teaching Complexity as Transdisciplinarity. In T. Carmichael, A. J. Collins, & M. Hadžikadić (Eds.), *Complex Adaptive Systems: Views from the Physical, Natural, and Social Sciences* (pp. 223–250). Springer International Publishing. https://doi.org/10.1007/978-3-030-20309-2_11

- DiSalvo, C., Sengers, P., & Brynjarsdóttir, H. (2010). Mapping the Landscape of Sustainable HCI. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1975–1984. <https://doi.org/10.1145/1753326.1753625>
- Dunne, A., & Raby, F. (2013). *Speculative Everything: Design, Fiction, and Social Dreaming* (1st edition). The MIT Press.
- Escobar, A. (2018). *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds*. Duke University Press Books.
- Fallman, D. (2008). The Interaction Design Research Triangle of Design Practice, Design Studies, and Design Exploration. *Design Issues*, 24(3), 4–18. <https://doi.org/10.1162/desi.2008.24.3.4>
- Finkelstein, M. A. (2001). Toward a unified view of scholarship: Eliminating tensions between traditional and engaged work. *Journal of Higher Education Outreach and Engagement*, 6(2), 35–44.
- Fry, T. (2011). *Sustainability is meaningless—It's time for a new Enlightenment*. The Conversation. <http://theconversation.com/sustainability-is-meaningless-its-time-for-a-new-enlightenment-683>
- Gaziulusoy, I., & Oztekin, E. (2018). Design as a Catalyst for Sustainability Transitions. *Design Research Society Conference 2018*. DRS 2018. <https://doi.org/10.21606/dma.2017.292>
- Irwin, T. (2018). The Emerging Transition Design Approach. *DRS 2018*, 3, 968–989. <https://doi.org/10.21606/drs.2018.210>
- Irwin, T., Kossoff, G., Tonkinwise, C., & Scupelli, P. (2015). *Transition design 2015*.

- Irwin, T., Tonkinwise, C., & Kossoff, G. (2020). Transition Design: An Educational Framework for Advancing the Study and Design of Sustainable. *Cuadernos Del Centro de Estudios En Diseño y Comunicación. Ensayos*, 105, 31–65.
- Iversen, O. S., Halskov, K., & Leong, T. W. (2010). Rekindling values in participatory design. *Proceedings of the 11th Biennial Participatory Design Conference*, 91–100. <https://doi.org/10.1145/1900441.1900455>
- Karahasanović, A., Culén, A. L., Skjetne, J. H., & Hasle, G. (2020). Key Performance Indicators in Design for Sustainable Rural Transport. *IADIS International Journal on Computer Science & Information Systems*, 15(2).
- Klein, J. T., Grossenbacher-Mansuy, W., Häberli, R., Bill, A., Scholz, R. W., & Welti, M. (Eds.). (2000). *Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society--An Effective Way for Managing Complexity* (2001st edition). Springer.
- Koepfler, J. A., Stark, L., Dourish, P., Sengers, P., & Shilton, K. (2014). Values & design in HCI education. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems* (pp. 127–130).
- Kolb, D. A. (1983). *Experiential Learning: Experience as the Source of Learning and Development* (1 edition). Prentice Hall.
- Kossoff, G. (2015). Holism and the reconstitution of everyday life: A framework for transition to a sustainable society. *Design Philosophy Papers*, 13(1), 25–38.
- Lindtner, S., Hertz, G. D., & Dourish, P. (2014). Emerging Sites of HCI Innovation: Hackerspaces, Hardware Startups & Incubators. *Proceedings of the SIGCHI*

- Conference on Human Factors in Computing Systems*, 439–448.
<https://doi.org/10.1145/2556288.2557132>
- Lockton, D., & Candy, S. (2018). Vocabulary for Visions in Designing for Transitions.
Design Research Society Conference 2018, 908–926.
<https://doi.org/10.21606/dma.2017.558>
- Max-Neef, M., Elizalde, A., & Hopenhayn, M. (1992). Development and human needs.
Real-Life Economics: Understanding Wealth Creation, 197, 213.
- Meadows, D. H. (1999). *Leverage points: Places to intervene in a system*.
- Meyer, M. W., & Norman, D. (2020). Changing Design Education for the 21st Century.
She Ji: The Journal of Design, Economics, and Innovation, 6(1), 13–49.
<https://doi.org/10.1016/j.sheji.2019.12.002>
- Peterson, T. H. (2009). Engaged scholarship: Reflections and research on the
 pedagogy of social change. *Teaching in Higher Education*, 14(5), 541–552.
- Raworth, K. (2017). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*. Chelsea Green Publishing.
- Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning.
Policy Sciences, 4(2), 155–169. <https://doi.org/10.1007/BF01405730>
- Rohrbach, S., & Steenson, M. (2019). Transition design: Teaching and learning.
Cuadernos Del Centro de Estudios En Diseño y Comunicación. Ensayos, 73, 232–261.
- Scholz, R. W. (2020). Transdisciplinarity: Science for and with society in light of the
 university's roles and functions. *Sustainability Science*, 15(4), 1033–1049.
<https://doi.org/10.1007/s11625-020-00794-x>

- Schön, D. A. (1983). *The Reflective Practitioner: How Professionals Think In Action* (1 edition). Basic Books.
- Sevaldson, B. (2011). GIGA-Mapping: Visualisation for complexity and systems thinking in design. *Nordes, 0*(4).
<http://www.nordes.org/opj/index.php/n13/article/view/104>
- Srivastava, S., & Culén, A. L. (2018). Transition-oriented Futuring: Integrated Design for Decreased Consumption amongst Millennials. *DRS 2018: Catalyst, 3*, 927–940. <https://doi.org/10.21606/drs.2018.210>
- Srivastava, S., & Culén, A. L. (2019). From Niche to Mainstream Transitions: Digital Second-hand Markets for Millennials. *Proceedings of the International Conference ICT, Society and Human Beings 2019*, 19–27.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., & De Wit, C. A. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science, 347*(6223), 1259855.
- Tonkinwise, C. (2015). Design for Transitions – from and to what? *Design Philosophy Papers, 13*(1), 85–92. <https://doi.org/10.1080/14487136.2015.1085686>
- Yakman, G., & Lee, H. (2012). Exploring the Exemplary STEAM Education in the U.S. as a Practical Educational Framework for Korea. *Journal of the Korean Association of Science and Technology, 32*(6), 1072–1086.