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Incorporating transition design in the education of an established design subject to empower design students with systems thinking

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Abstract

Designers' roles are at a turning point of transforming design from an expert-driven design process within an assumed social and economic order to design practices that advocate design-led societal transition toward more sustainable futures. Design education should be adapted accordingly. Introducing the transition design concept into established design education promotes the sustainable society transition by involving more systems thinking from designers in various sectors. This study reports on a pilot practice and reflection on introducing the transition design concept to design students.

Keywords: transition design, systems thinking, design education, complex systems, sustainability

1. Introduction

The role of designers is at a turning point of transforming design from an expert-driven process focused on objects and services within a taken-for-granted social and economic order towards design practices that advocate design-led societal transition toward more sustainable futures (Irwin, 2015). Additionally, emerging technologies such as internet-of-things, machine learning and artificial intelligence are increasingly challenging established design traditions, with for example blurring the borders between design and use, bringing more-than-human agencies to the fore, and contributing to broader societal shifts (Giaccardi & Redström, 2020). Design education should be adapted accordingly. As Escobar described in his book "Designs for the pluriverse", it is critical for us to consider transitions in design, and we need to have systems thinking by stepping outside the existing institutional and epistemic boundaries (Escobar, 2018). By introducing the idea of sociotechnical imaginaries, which is defined as 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology', Jasanoff and Kim (2015) strengthen the argument of introducing systems thinking in future designs. Systems thinking is defined as a methodology used to create structural explanations for why things are happening to be able to identify long-term sustained strategies that will fundamentally improve system performance (Payne, 2022). It is considered have complementary strength with design thinking (Buchanan, 2019). On the one hand, systems thinking reveals the linkages, interdependencies, and complexity of our surroundings, but it is only through the discipline of design that action can be taken (Buchanan, 2019). On the other hand, designers also recognize the importance of creative inquiry to understand the nature of systems and the rules that govern them (Buchanan, 2019). A prior study described the incorporation of a systems thinking course into industrial design education, and the findings show the facilitative effect of systems thinking in learning design research at an early level of the industrial design curriculum (Bayraktaroğlu, 2022).

Design education has emerged at a rapid speed with quick assimilation of new knowledge, causing the current dynamics. Established subjects like product design (Chandrasegaran et al., 2013), interaction design (Fallman, 2008) , service design (Zomerdijk and Voss, 2010), social innovation design (Manzini, 2015), speculative design (Dunne and Raby, 2013), deep design (Gosling, 2020), meta design (Fischer, and Scharff, 2000), as well as concepts such as human-centered design (Steen, 2012), user-centered design (Norman, 1986), participatory design (Björgvinsson et al., 2010), co-design (Zamenopoulos and Alexiou, 2018) are all acknowledged and evolving. However, when the complexity of the challenge that human society is confronting rises, certain limitations on these subjects and concepts become apparent. For example, subjects like product design are in a constrained spatio-temporal setting and require immediate solutions which challenges the sustainability of the design solutions. Concepts like human-centered design and user-centered design privilege the concerns of some over others [9], which can often make implementation difficult when a variety of stakeholders are involved. With these limitations, when dealing with issues such as poverty, climate change, COVID management, etc, those subjects and concepts are challenging to be effectively applied. We refer to those issues as wicked problems, which are characterized as the type of challenges that become morally repugnant for the planner to address (Rittel & Webber, 1973). Designers are given a moral obligation to address the issue on both a small and a systemic level, as every tiny obstacle is tied to a greater scale. Systems solutions are more likely to be sustainable compared to one-off solutions. Irwin therefore mentioned that to promote sustainable societal transitions through system-level design practices, designers need new knowledge, new tools, and new approaches (Irwin, 2020).

Transition design is a transdisciplinary approach aimed at addressing the wicked problems confronting 21st century societies and catalysing system-level change (Irwin, 2020). It aids in "facilitating stakeholders in the co-creation of visions of desirable futures and identifying leverage points in the large problem system in which to situate design interventions" (Irwin, 2020). Transition design differs from the previously described design subjects and concepts in that it solves problems in a broader spatio-temporal context and designs for sustainable futures (Scupelli, 2015). We are always in the status of getting used to the consequences and ramifications from the constant transition of our society, but what we need to consider is how to take the initiative to change the trajectory (Irwin, 2015). Transition design framework provided a three-phase approach: 1) Reframing present and future; 2) Designing interventions; 3) Waiting and observing (Irwin, 2015). Plenty of existing methods have potential to be embedded in each phase as the inclusiveness nature of transition design framework. It promotes systems thinking among designers by integrating transition design into design education.

One of the important components of transition design framework is collective intelligence among stakeholders, as it deals with the wicked problems where various stakeholders are involved. Health CASCADE is one of the European Union-funded multidisciplinary expert networks with the ultimate goal of delivering the rigorous scientific methodology to consolidate co-creation as an effective tool to fight public health problems (Verloigne et al., 2022). Co-creation is defined by Health CASCADE as an evidence-based methodology for the development, implementation, and evaluation of innovations through continuous, open collaboration, interactional knowledge production and shared decision-making among key stakeholders, directed at improving public health" (Messiha, 2021). One of the tasks of Health CASCADE is to cascade co-creation skills and expertise by training a new community of professionals capable of working across disciplines, and public and private sectors. Designers are one of the potential targets due to their interdisciplinary knowledge base. Because co-creation exists at all phases of transition design and it is practical in nature, knowledge of transition design may be more easily disseminated and understood when knowledge of co-creation is coupled. Incorporating co-creation processes into transition design phases aids in the exploration of more possibilities for transition design framework, and on the other hand, the notion of transition design can conversely aid the development of co-creation at a system-level.

Although the transition design subject has taken on the genre in university education, there have been few reports on incorporating transition design into established design education, such as product design, interaction design, etc (Scupelli, 2019). Introducing transition design into design education can be complicated due to its nature of interdisciplinarity. The transition design project entails long-term efforts, which may explain why understanding it through a short-term activity is challenging. However,

by doing so, it accelerates the transition to a more sustainable society by incorporating more and more systems intervention ideas from designers in various fields. In this article, we present: (1) a pilot practice and reflection of introducing transition design concept to design students through a co-creation workshop, and 2) further advice on delivering systems thinking to design education.

2. Methods

This is an exploratory study on the perception of students regarding the transition design as part of the course "Interaction Design and Emergent Technologies" to grow systems thinking. It explored their perspectives on workshops as an interactive learning method, and the supportive potential of incorporating co-creation when introducing the transition design concept. The participants are students from the Master Programme in Human Computer Interaction and User Experience at the Department of informatics of the Umeå University in Sweden. The course chosen to introduce transition design was "Interaction Design and Emergent Technologies". This course has the goal of preparing students to sensitively approach the design of emerging digital technologies—such as for example smart environments, social robots, and the Internet of Things (IoT)—, how can they practically be applied in different societal contexts. As such, this course introduces students to different tactics of design futuring. These are not aimed to provide solutions or targets but rather aim to open up critique, discussion, debate, and questioning about alternative futures. As many networked and AI-based technologies are challenging the notion of interaction, where things that may appear familiar to end-users are increasingly part of an ecosystem and process that may be hidden from view, this course aims to introduce design students to tactics and approaches that allow students to map interactions between systems, actors, and the effects of these interactions (Comber et al., 2019). As such, the transition design lecture and workshop were constructively aligned with the intended learning outcomes of this course (Biggs and Tang, 2011).

2.1. Introducing transition design

The transition design lecture lasted one hour, and there was another hour left for a co-creation workshop among students. For the lecture, with the goal of helping students understand why and how to use transition design, we demonstrated one case of employing transition design facilitated by co-creation to address the early discharge problem of people with chronic obstructive pulmonary disease in Sweden. By introducing co-creation approach, we aim to establish a common foundation for comprehending the phases of transition design, as the concept of co-creation fits into each phase. The concepts that form transition design were described through the presentation of the example practice. The lecture primarily explained the concept of co-creation and the fundamental concepts of transition design framework, which include wicked problems, futures cone, and backcasting.

2.2. Data collection and analysis for co-creation workshop

A co-creation workshop could empower students as co-creators in the learning process (Elsharnouby, 2015). Students who consider themselves as co-creators could take responsibility for their learning and use teachers and other resources to support their effort and ensure more successful outcomes (Elsharnouby, 2015). In the co-creation workshop, the students were instructed to partner up with more than 2 people in each group. For the group tasks, each group was asked to explore the ecology of system interventions for an identified wicked problem. A design brief and a group task sheet were given to each group (Appendix A). The Sustainable Development Goals (SDGs) (i.e., an urgent call for action by all countries to contribute to the peace and prosperity for people and the planet, now and into the future) (United Nations, 2015) and wicked problems are addressed in the design brief. They were asked to choose a wicked problem based on their experience and preferences and have a discussion on the chosen problem. Following that, each group filled out the group task template with the possible data collection and analysis methods. They then utilized a roleplaying exercise in which each group member acted as a stakeholder affected by the chosen wicked problem to explore system intervention concepts and attempt to uncover an ecology of system interventions. Finally, after presenting their report group by group and receiving feedback from one another, an anonymous evaluation form is offered to individuals to collect

the difficulties they have experienced in learning transition design. The questionnaire includes a 5-point Likert scale and an optional question concerning the difficulties respondents may have comprehending transition design to reduce possible answer load. Data collected from the workshop mainly comprise student group project reports and individual evaluation forms. Students submitted both documents after their final presentations. These documents can complement each other in terms of understanding students' learning outcomes. Throughout the process, the researcher (Q.A.) kept notes. The completion of the group projects can demonstrate conceptual comprehension, meanwhile the scale and the question in the evaluation form help to examine the barriers and enablers when adopting transition design in established design education. The scale data were analyzed with descriptive statistics.

3. Results

Ten students divided themselves into three groups for the tasks. There were eight males and two females among the participants. Transition design projects initiated by student groups include 1) the public transport is inaccessible in Sweden, 2) the safety issues in the urban area next to the university campus (i.e., a student housing cluster area in Umeå, Sweden), 3) access to affordable and close housing to the working place and school (Table 1).

Table 1. Group reports from students

Group No.	Wicked Problem	Stakeholders	Methods
1	The public transport is inaccessible in Sweden	Ultra, petrol station, people using public transport	Cultural probes, interview, workshop, post-its
2	The safety issues in the urban area next to the university campus	Citizen, municipality, police, energy companies, construction companies, EU, UN, Swedish government	Interviews, focus group,
3	Access to affordable and close housing to the working place and school	Government, architectures, urban designers, housing rental companies, residents	Interviews

3.1. Group project reports

3.1.1. Group 1: The public transport is inaccessible in Umeå, Sweden

Based on their personal experience, they found that the inaccessible public transportation is a wicked problem, particularly in rural areas of Sweden. It is a long-standing issue involving multiple stakeholders and is linked to other issues such as high transportation costs and barriers to tourism development. Ultra (i.e., Umea's bus system), petrol station, and people who use public transportation are among the recognized stakeholders. They chose cultural probes, post-it notes, interviews, and workshops as their methods. They intended to employ cultural probes with people who use public transportation a lot to know more about their daily challenges about using public transportation. Interactive workshops could assist in envisioning their preferred futures. Following a brief role play practice, the preferred future life was presented, which include creating lower-cost and more accessible public transportation lines throughout Sweden. The possible systems intervention concepts include more benefits for public transport workers and more transportation options.

3.1.2. Group 2: The safety issues in the urban area next to the university campus

The urban area next to the university campus may not always be a secure location in Umeå. Yet, because of its proximity to the university, the area is home to a large number of students. The problem is wicked because there are several stakeholders involved with competing interests, and if there is a solution, it

may take a long time to evaluate the solution. Citizens, municipalities, police, construction businesses, the EU, UN, and the Swedish government are among the stakeholders. To approach the problem, they planned to employ focus groups, interviews, post-its, and second-hand data from the city. The preferred future is a safer area. They didn't have enough time or knowledge of their roles to develop system-level initiatives.

3.1.3. Group 3: Access to affordable and close housing to the working place and school

The lack of accommodation in Umeå has been a serious issue, and it worsened after the pandemic. This group of students believe that people should not travel a long distance to work, and this intersects with problems such as urban planning and economic inequality. The housing problem is a wicked problem because it cannot be solved and is linked to other issues. Fundamentally, population growth over the last decade has exceeded all expectations, and the current construction pace is far too slow to supply the number of dwellings required to accommodate all people. The identified stakeholders include government, architects, urban designers, housing rental companies, and residents. The method in plan includes interviews. Due to the time limit, they didn't get to the phase of intervention ideas. The problem definition took up most of the time.

3.2. Evaluation form

There are two parts in the evaluation from: a Likert scale for evaluating the comprehension of the key concepts in transition design, and an open-ended question about the most challenging aspect of understanding the concepts. Table 2 shows the mean value and standard deviation value for each item on the Likert scale. The most significant challenges students have encountered when learning transition design include 1) they need a slower pace; 2) more practical examples; 3) hard to understand the concept of preferred futures and backcasting; 4) have difficulties in differing it with service design and other concepts, as they are deeply ingrained in mind; 5) how to collect reliable data and how to make a sustainable design using transition design framework.

Table 2. Results from the Likert scale for comprehension of key concepts in transition design

Item	Mean (M)	Standard Deviation (SD)
Wicked Problem	4.4	0.80
Transition Design	3.9	0.83
Futures Cone	3.5	0.67
Co-creation	3.7	0.90
Backcasting	3.4	1.11

Note. 1: I don't know it at all; 5: I have a general grasp of what it is and would like to learn more about it

4. Discussion

4.1. Principal findings

This study described a workshop attempt delivered to incorporate the transition design framework into design education to promote the systems thinking of designers. Incorporating the knowledge of co-creation into transition design learning helps disseminate the concept to students through providing a practical exercise. The co-creation workshop was validated as a useful tool for facilitating an interactive learning process. The three group projects illustrate a good level of grasp of the associated concepts. Meanwhile, the group projects highlight the problem's regionalism and the dynamism of the methods that can be deployed. To cater the interdisciplinary nature of transition design, more creative method options could be provided and explained to open up conversations in the workshop. Because there are many concepts involved in comprehending transition design, distinctions between them must be thoroughly addressed, preferably using a taxonomy to explain various concepts. With the taxonomy, students can easily find the definition of each concept and understand the relevant concepts inside the transition design framework throughout the learning process. To conclude, this endeavor demonstrates

the potential of incorporating transition design into some of the design assignments in design education. The potential audience of this study could include design instructors across disciplines, design researchers, and systems thinking educators. The findings of this study could help shape future practices for incorporating systems thinking into design education in various fields.

4.2. Challenges in introducing transition design

As the students reported, the main challenges in learning transition design include: 1) the distinction between transition design and other concepts. Without a complete project practice, some students commented that it is challenging to distinguish transition design from service design. These design concepts cannot be explained literally. Briefly, service design is "a process in which designers create sustainable solutions and optimal experiences for both customers in unique contexts and any service providers involved" (The Interaction Design Foundation, 2016). The proposed outcome of service design is the improved experience among stakeholders, especially end users through the stakeholder mapping, while the proposed outcome of the transition design is an ecology of system interventions to cope with a wicked problem. Additionally, service design is centred on designs in current/dominant socioeconomic-political paradigms, whereas transition design employs backcasting. Transition design contends that current paradigms are intrinsically unsustainable/inequitable and must be completely reimagined if our communities, organisations, and entire society are to move to more sustainable long-term futures (Irwin, 2020). 2) comprehension of the concept of systems interventions where the interventions scaffold each other. It can be challenging to understand without an established systems thinking or practical experience of system-level design projects. Exploring systems interventions could help designers gain a better understanding of the system, as well as identify and improve design initiatives within the system. 3) the nature of interdisciplinarity of transition design can be inaccessible for students. It is difficult to target fundamental skills needed by students to demonstrate in a transition design project, as Scupelli (2019) pointed out. Since transition design is an interdisciplinary topic, the argument is supported by numerous references, making it difficult to completely comprehend. Similar to a bookcase, the transition design framework connects various established concepts. It can be challenging for students who are new with the concepts to read the reports for those concepts that are crucial to transition design. One concept may be related to another aspects of knowledge, such as an understanding of preferred futures. It should be supplied through the cone of possibilitis (Dunne and Raby, 2021). Thus, it's important to know how to simplify difficult ideas so that students can understand them, especially for those who are unfamiliar with them.

In general, more practice is needed for integrating transition design into established design education. Systems thinking is a valuable ability for designers, as it could help designers to address issues in a systemic way. From the completed projects by students, we noticed that students struggle with considering a longer horizon when imagining futures. This is also reflected on their choice of methods which are focused on the present, or probe preferable futures only the short-term. In future work we intend to introduce new methods such as forecasting, or fabulation (Søndergaard et al., 2023) in order to consider different time scales and foster dialogues across different types of knowledges, seeking common grounds while reserving difference.

4.3. Advice on future practice of incorporating transition design into established design education

As mentioned by the participants, transition design is a heavy concept and not easy to capture. Based on the introduced concepts, we found that the interactivity of the learning process has great impact on the understanding of each concept. More interactive learning techniques are needed when introducing the concept. We advise adopting creative concept learning techniques, such as storytelling, and emphasizing the differences and memorization of each concept. The concepts should be made available for self-study with guidance. It is also applicable to incorporate the transition design concept into their design projects, as students stated in the evaluation forms that it is a fascinating topic to study and will be easier for them to understand if explained through more practical examples. Furthermore, the group projects completed by the students demonstrate that the workshop should be adapted into other contexts (e.g., students in other design courses, different countries, etc.) by taking culture, education background, techniques, and

knowledge base of students into account. We suggest that concepts in transition design, when implemented in traditional design education, should build on students' current knowledge of design practices, aiming to complement and extend different ways of doing design. Furthermore, co-creation contributed to a better understanding of transition design, whether as a medium for introducing concepts or a method of transmitting knowledge. On the one hand, co-creation helps in clarifying the practical steps at various phases. On the other hand, it could also be used as a teaching strategy to help students learn.

4.4. Limitations and strengths

Given the transition design involves various intricate concepts, one of the limitations of this study is the limited time for introducing the concepts. Furthermore, because of time constraints, the possibility for students to apply their knowledge of systems thinking to other projects or actions is not adequately explored. The potential of incorporating transition design into design education, as well as the supporting role of co-creation in delivering transition design concepts to students, is the report's most significant strength. Students were positive in learning the concept and are interested in further exploration. Future steps are suggested to adapt the transition design workshops into different design education subjects to promote the systems thinking in designers.

5. Conclusion

This study reported an attempt to introduce transition design to design students to promote systems thinking among them. As we know the necessity of introducing these concepts to design education, the reflection can of great value for future practice. Future research will focus on further developing the co-creation workshop for transition design learning targeting design students from various areas.

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Appendix A

Design brief

DESIGN BRIEF

BACKGROUND

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". **The Sustainable Development Goals (SDGs)** are 17 broad and interdependent that the United Nation defined in the Agenda 2030 resolution, and which its member countries have vowed to achieve until 2030. The goals are specified by 169 more concrete targets, which in turn are further specified into indicators, which are measurable outcomes that are used to monitor goal fulfillment.
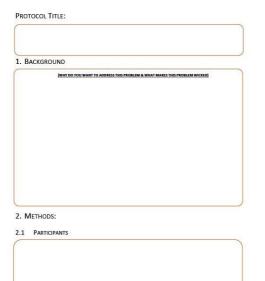
The SDGs and its targets and indicators serve to identify the greatest global challenges to sustainable development and provide a roadmap for the desired development of the world, spanning across e.g. social, environmental, economic and health-related areas. Agenda 2030 has become a highly influential document and is today present in all spheres of society and curricula at all educational levels.

WHY IS THE TASK?

Wicked problems which are defined as the dimension of difficulties that becomes morally repugnant for the planner to address are situated in SDGs. Transition design aids in "facilitating stakeholders in the co-creation of visions of **desirable futures** and identifying **leverage points** in the large problem system in which to situate design interventions".

WHAT IS THE TASK ABOUT?

- Step1: Team up (>=2)
- Step2: Choose a wicked problem based the SDGs (see https://sdgs.un.org/goals). The wicked problem has to be chosen from the ones are faced by Sweden right now (e.g. healthcare staff shortage, increasing difficulty in recruiting staff to provide different welfare services…..)
- Step3: Use the template sheet to complete a protocol for a potential transition design study to address the identified wicked problem
- Step4: Identify at least two roles as stakeholders who are involved in the wicked problem and role play the process with your teammate(s).
- Step5: Presentation of your protocol and your intervention points

WICKED PROBLEM

I. They do not have a definitive formulation.
II. They do not have a "stopping rule." In other words, these problems lack an inherent logic that signals when they are solved.
III. Their solutions are not true or false, only good or bad.
IV. There is no way to test the solution to a wicked problem.
V. They cannot be studied through trial and error. Their solutions are irreversible so, as Rittel and Webber put it, "every trial counts."
VI. There is no end to the number of solutions or approaches to a wicked problem.
VII. All wicked problems are essentially unique.
VIII. Wicked problems can always be described as the symptom of other problems.
IX. The way a wicked problem is described determines its possible solutions.
X. Planners, that is those who present solutions to these problems, have no right to be wrong. Unlike mathematicians, "planners are liable for the consequences of the solutions they generate; the effects can matter a great deal to the people who are touched by those actions."

SUSTAINABLE DEVELOPMENT GOALS

I. GOAL 1: No Poverty
II. GOAL 2: Zero Hunger
III. GOAL 3: Good Health and Well-being
IV. GOAL 4: Quality Education
V. GOAL 5: Gender Equality
VI. GOAL 6: Clean Water and Sanitation
VII. GOAL 7: Affordable and Clean Energy
VIII. GOAL 8: Decent Work and Economic Growth
IX. GOAL 9: Industry, Innovation and Infrastructure
X. GOAL 10: Reduced Inequality
XI. GOAL 11: Sustainable Cities and Communities
XII. GOAL 12: Responsible Consumption and Production
XIII. GOAL 13: Climate Action
XIV. GOAL 14: Life Below Water
XV. GOAL 15: Life on Land
XVI. GOAL 16: Peace and Justice Strong Institutions
XVII. GOAL 17: Partnerships to achieve the Goal

Group task sheet

PROTOCOL TITLE:

1. BACKGROUND

[WHY DO YOU WANT TO ADDRESS THIS PROBLEM & WHAT MAKES THIS PROBLEM WICKED]

2. METHODS:

2.1 PARTICIPANTS

2.2 DATA COLLECTION & ANALYSIS

Phases	Steps	Methods	Description	Proposed Outcome
Reframing: The Present and Future	Mapping the problem in the present			(Causes and consequences of the problem)
	Mapping stakeholder concerns & relations			(Relationships among stakeholders based on their fears/concerns, and hopes/desires)
	Future visioning			(Preferred future lifestyle)
	Backcasting			(Tangible projects)
Designning interventions				(Interventions)