REORIENTING DESIGN THINKING THROUGH SYSTEMS THINKING

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ABSTRACT
In this paper, we discuss how systems thinking can serve as an entry point to a re-oriented design thinking process model where equal value is attached to nature, the non-human and the humane. Design thinking matured at a time (mid 90s - 00s) when climate and environment did not receive the same attention as in recent years. We believe that design thinking still has its justification as a process tool. However, we want to discuss if design thinking as a process tool can be strengthened if we supplement the process with a consistent focus on ecosystems and systems thinking. In this paper, we specifically address and discuss the role of systems thinking and systems mapping as perspectives to reorient the design thinking process in the 2020s where natural recovery and green transition should have the highest priority as a result of the general state of the planet. In two projects, a module course for innovation and entrepreneurship and an international co-curricular project on systems mapping, we have employed systems thinking at different phases in the design thinking process. In this paper, we evaluate in which ways and to what extent systems thinking has contributed to the learning process. We exemplify and argue how students have obtained a deeper understanding of the complexity of 'wicked problems' and the mechanisms causing them. In conclusion, we point to a potential for reorienting the design thinking process by combining it with systems thinking and approaching it as a continuous movement between ontological and operational perspectives.

Keywords: Design thinking process, systems thinking, GPA Map the System, Design for Change

1   DESIGN EDUCATION FOR SUSTAINABLE DEVELOPMENT
In the OECD's 2030 Future of Education and Skills report, design is the most frequent word used to describe examples of new, emerging jobs and future skills for a complex and changing world [1]. Moreover, the World Economic Forum's Future of Jobs report particularly mentions and describes design as one of the most significant change-making practices [2: 36]. The distinctive approach to problem solving through a human-centred and visually-oriented methodology employed by designers— also central to design thinking—strives to develop new opportunities instead of selecting from already existing alternatives [3]. When designers engage in wicked problems [4, 5], they often develop new methods [6, 7]. This requires an awareness of the educators designing the curricula about which type of design they are aiming at but also on what premises - on what ontological basis they work.

In 1992, Buchanan suggested a design typology consisting of four orders of design [5]. He described the first order of design as communication with symbols and images and the second order as industrial design, engineering or architecture focusing on physical artefacts. The third order is described as interaction design in services and is about how people relate to other people. Finally, Buchanan pointed at the fourth order of design as the design of the environments and complex systems. Buchanan emphasized that *"[s]igns, things, and actions are organized in complex environments by a unifying idea or thought",* that is, the three first orders of design exist within the fourth order (5: 10).

Aiming to direct students towards the third and fourth orders of design points towards including systems thinking as it allows us to reorient our thinking from being entity-focused (a product, a local problem, a specific person) to include multiple entities (products and services, multiple problems, multiple stakeholders), their interrelations, the dynamics of the system, and very importantly the different scales of the system [9]. Other researchers have linked design thinking and systems thinking within the field

of design and sustainability [10, 11], but also earlier design research seems to point to systems thinking [12]. Buchanan explains it in this way:

"Systems thinking reveals the complexity, interrelationships, and many of the interdependencies that exist in our surroundings. But it does not lead to action except through the agency of the discipline of design, an art of action. Design is more than the set of methods and techniques to which it is often reduced in the approaches of system thinking. Design and the thinking upon which it depends is a cultural and humanistic art, a discipline of transforming surroundings into environments for human experience" [8:100].

Our intention with combining systems thinking with design thinking is to provide students with an understanding of the status quo and the dynamics and scales of a specific system, thus providing them with tools of action through design thinking process models. Systems thinking contributes to identify system interrelations where changes can be put in action. That is, it can create an understanding of beneficial points of intervention. Meadows promotes these as leverage points where the scale of the interrelation and the leverage point together define the scale of the potential change an action brings [13].

2   DESIGN THINKING AS A PROCESS TOOL

In the last decades, design thinking has been widely used as a process model in educational as well as in business contexts, especially. This was heavily influenced by the work of Tim Brown and IDEO at the beginning of the 2000s [14]. This seems to have moved the focus of design thinking from being a process to solve 'wicked problems' such as environmental issues and inequality [4, 5] to being a process predominantly applied to ensure continuous growth in a conventional linear growth paradigm. In that way, it can be argued that design thinking has moved from a focus on design in the fourth order (environmental designs and system interventions), and third order (interaction design) to a predominant focus on design in the first and second order (products and services). Thus, we contend that time has come to initiate a transformation from user-centred to beyond-human centred design. This paper presents elements of our work with reorienting design thinking through systems thinking and mapping for pluralistic futures.

Design thinking matured at a time (mid 90s - 00s) when climate and environment did not receive the same attention as in recent years. We believe that design thinking still has its justification as a process tool. In this paper, we specifically address and discuss the role of systems thinking and systems mapping as perspectives to reorient the design thinking process in the current context where recovery of (natural) resources and green transition should be given highest priority. Design thinking emphasizes research as the first step of defining a relevant problem. This can typically be in the form of 'empathizing' (Ideo, Stanford), 'discovering' (Double Diamond, British Design Council) or 'finding' (5F, VIA University College). Common for these models is that they are based on an Anthropocene understanding with a human-centred focus. In this paper, we discuss how systems thinking can serve as an entry point to a reoriented design thinking process model where nature and the non-human are given equal consideration as humans.

3   RESEARCH METHODOLOGY

In this study, we base our research on two educational projects from HE in design. We have employed systems thinking at different phases in the design thinking process. 'Design for Change' (DfC) is a three-week course module with 48 'Entrepreneurship and Innovation' BA students on their 5th semester. The students have applied systems thinking to their projects throughout the whole process with an intensified focus on the solution. The purpose of the Design for Change course module is to qualify students to take part in and use their maturing professional knowledge to work with complex, sustainable, circular and socially oriented design solutions.

'GPA Map the System' (MtS) is a 10-week long learning experience offered in collaboration between Canadian Humber College, Otago Polytechnic and VIA University College for students to build key competencies for sustainable development through activities focused on systems thinking and mapping [15]. The students have used systems thinking specifically in the initial phases to find and re-frame a problem through systems mapping.

It applies to both educational projects that the students are familiar with and have worked with one or more versions of design thinking as a process tool. The students have worked in groups of 4-5 people, and we have selected representatives from different groups for interviews. We use the interviews as a

foundation for our discussions. We have worked qualitatively with an interview guide with open questions focusing on the students' experiences with systems thinking and mapping. The subsequent analysis is conducted according to the following four themes: 1) reflections on the work with systems thinking, 2) new perspectives in working with innovation projects, 3) the relationship between systems thinking and design thinking, 4) transfer of new knowledge about systems thinking and mapping for subsequent projects.

Our main interest in this paper is the students' reflections on design thinking combined with systems thinking. Therefore, and due to limited space, we do not bring examples from teaching but focus solely on the interviews. The interviews have been conducted physically or online with the participation of two researchers and one student. Each interview had a duration of approximately half an hour. Each interview has been recorded and transcribed and supplementary notes have been taken.

4 INTERVIEWS & ANALYSES

The thematic analysis reveals that the students have obtained very different types of insights during their introduction to systems thinking, indicating that there are different levels of abstraction. Though insights gleaned from a few broad interviews do not provide strong evidence, they are valuable from a didactic perspective as input for further investigations into reorienting our didactic approach to design thinking Some students reveal how systems thinking has provided them with a set of tools that enable them to operationalize systems thinking (e.g., through systems mapping) and use it communicatively to ensure that team members have a common understanding of the problem. Others have gained an increased ability to identify and engage in the interplay between elements that – in combination – create the complexity of wicked problems.

Overall, it seems that all students have gained an increased awareness of the complexity that surrounds them and that problems are multi-layered. However, there appears to be considerable differences in the understanding of the interrelation between complexity, wicked problems and systems thinking. Some students elaborate on their experiences with concrete examples of systems thinking methods and tools they have used, specifically emphasizing systems mapping. However, they appear less familiar with the ontological perspectives of systems thinking. Other students explain how obtaining knowledge about systems thinking has contributed to constructing better research questions, thus enabling them to address elements that lie beneath the surface.

The following key insights from the interviews are divided into the four themes. The two types of learning outcomes - operational and ontological – are illustrated for each theme.

4.1 Reflections on the work with systems thinking

Through their experiences with applying systems thinking in the GPA Map the System project as well as in subsequent courses, a student had developed an understanding and appreciation of systems and the depth and complexity that they entail:

> *"Systems are all around us, we just don't see it… we don't realise it… and then when you really dive in for it, you find out that a lot of areas are not transparent… There are a lot of why's behind and sometimes you can [desk] research for the why, but sometimes you need to get the primary research as well. You need to talk to people to understand and even people who work within the system, let's just say the waste management people, they also couldn't answer that question because they're in the loop. They can't think about why because this is just what they do daily" (Student C, MtS).*

In trying to get to the 'why' of something, the student has come to the realization that while primary research with embedded stakeholders of a system is often required, they (the stakeholders) might not be able to see the system from the outside. They do not have or cannot take the perspective that systems thinking offers.

The same student offers an operational perspective as well that taps into an ontological learning outcome.

> *"I think we need to find a way to visualize or let's say translate what you thought and the whole system. It helped me a lot… To me when you have the tool, it's very simple to expand to people to see the big picture because when I just see it, it could be something messy and people maybe couldn't follow. But with all the tools, it helped a lot" (Student C, MtS).*

As the examples by this particular student show, the systems mapping tools have empowered the students to communicate systems thinking perspectives and invite others (e.g., fellow teammates or

stakeholders involved) into the arena of systems thinking where new understanding and knowledge can arise. Even without drawing them, the maps become conceptual frameworks for thinking in and about systems.

4.2 New perspectives on working with innovation projects

In hindsight, some students now see that prior to the course Design for Change, their projects had simplistic understandings of the problems they were working on, leading them to question the rationale behind their solutions or proposals. One student frame the learning outcome as

> *"Systems thinking is about going back to the roots, not leaving anything out, not treating the symptoms but addressing the underlying causes" (Student A, DfC).*

While some students might attack wicked problems head-on, albeit sometimes with a simplistic understanding of the problem, others might be hesitant and feel overwhelmed by the sheer complexity of the problem. As one student puts it:

> *"It definitely gave me a tool to try to map the complexity [...], there are some wicked problems and it's just confusing and hard to think about. And there's... Yeah, not much I can do. But with systems thinking, ideally it would be a tool to combat wicked problems" (Student E, DfC).*

Here, systems thinking operationalized through systems mapping seems to help some students overcome the feeling of inefficacy by giving them an overview of potential points of intervention.

4.3 The relationship between systems thinking and design thinking

Students from GPA Map the System as well as Design for Change emphasize that knowledge about systems mapping and systems thinking enables them to understand the status quo at the beginning of a design thinking process. Here it is expressed by a student from GPA Map the System:

> *"... Because we use the website Kumu.io. Because you have a lot of templates you could use different visualizations if you want. So first of all, we try to create categories for our project. We were working on food waste within the north of Europe, so Scandinavia. And so, first of all, it was to narrow it as much as possible because it would have been impossible to do it in the world. And so, at the beginning, each of us could present ideas and try to make maps, and then we would meet to try to see if we all agree with everyone's idea. And then we all met once. We could scrap out what was not working, try to make connections and always question why and why do we think it's connected?" (Student D, MtS).*

The student describes how systems thinking enables the group to work with and qualify the problem framing – a design thinking tool – supported (and challenged) by systems thinking.

4.4 Transfer of new knowledge about systems thinking and mapping for subsequent projects

Nearly all students expressed those systems thinking had contributed to understanding the complexity and how everything is connected to working with 'real-life' wicked problems. A student from GPA Map the System expresses how systems mapping and the communication platform the group used was an eye opener to the extent that s/he has used it afterwards for the individual BA project:

> *"But the mapping tool was really interesting, and I actually used this website again in my bachelor thesis and in my other projects afterwards because I just used it for myself sometimes, for example when I was brainstorming. When I was researching a topic, I would try to… if I had different topics in mind or different areas of research, I could put it in the center and try to see what would come up. I also used it in connection with engineering to list properties of materials and to test those properties" (Student D, MtS).*

Contrary, a student from Design for Change expressed how the mental model behind systems thinking was the most important learning take-away:

> *"I definitely think it can help me in solving problems. I mean I use it as a kind of a mental model. I don't use the different tools within systems thinking … Just using the mental model that thinks in terms of systems, thinks in terms of patterns, that is something helpful that I definitely took with me from the course" (Student E, DfC).*

This statement particularly emphasized that instead of introducing the concept of systems thinking and wicked problems at a high level of complexity, we should start with a more bottom-up approach and exemplify with less complex problems as a framework.

The analysis focusing on the four themes points to two perspectives of knowledge and doing. In the next section, we suggest discussing this as an ontological versus an operational perspective.

5 DISCUSSIONS

Unintentionally, the students use both an ontological perspective (their knowledge perspective) and an operational perspective (their "doing" perspective). Some students move effortlessly between the two perspectives. For these students, the ontological and operational perspectives are equally important, and they appear to move continuously between them in interconnected and expanding curves as their levels of knowledge and dimensions of abstraction expand (Figure 1).
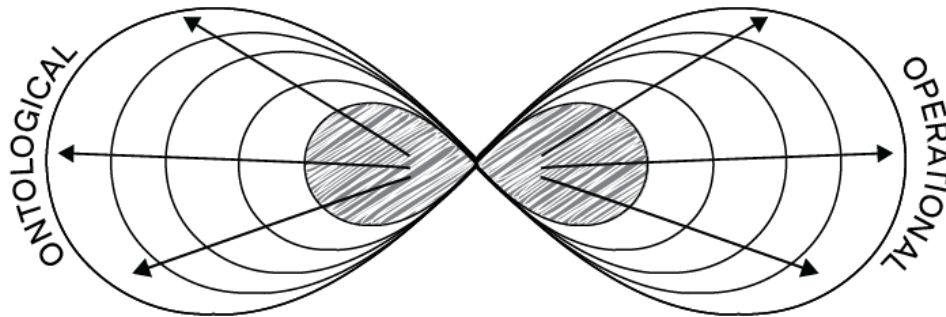

Figure 1. The figure shows the connection between ontological and operational perspectives and how the level of knowledge and dimensions of abstraction can expand.

The ontological and the operational perspective are thus approached as both/and rather than either/or. These students use systems thinking constructively as an approach to understanding 'wicked problems' by breaking them down into smaller entities that help reduce complexity. Other students are predominantly engaged in the operational perspectives and the use of the related tools.

Merging systems thinking with design thinking is not easy and requires fundamental awareness in the process – profound reflections on the ethics, values and principles of the systems in which the designer works. This calls for a revision of the ontologies on the basis of which we perceive the world. Buchanan explains:

> "The neglect of principles sometimes leads to the complicity of designers and system thinkers in the failures of the large platforms—technological or social— that affect our lives. Overcoming this neglect is a challenge for which the design and systems communities may not be well prepared, since there is often too little discussion of the nature and influence of principles in making and living our lives. Yet, it is the kind of challenge to which the disciplines and our diverse philosophical beliefs can turn if we have the will and the restless imagination that characterizes creative design" [8: 102].

As discussed in the analysis of the interviews, the introduction of systems thinking to design thinking has achieved some of the intended results; some students have obtained a deeper understanding of the complexity in 'wicked' problems and the mechanisms causing them. Thus, they pay more attention to and spend more time exploring and understanding the systems creating the problems. Though not conclusively, the students participating in GPA Map the System appeared to have gained a deeper understanding of systems thinking both as a concept to understand different ontologies *and* to employ different tools to map and communicate systems. Moreover, these students appeared more capable of reflecting on how they transferred their obtained systems thinking knowledge to subsequent projects and in general included it in their work approaches.

6 CONCLUSIONS

Since several students apparently perceived systems thinking as merely a set of tools to organize or map elements constituting their normal research process, e.g., mapping of stakeholders, research areas and data sets, it seems relevant to evaluate and scrutinize the didactic approach to systems thinking as integrated in design thinking. The big difference between the didactic approaches relates to the

introduction of systems thinking limited to the frontend of the design thinking process (GPA Map the System) against introducing systems thinking throughout the whole design thinking process with high focus on the final idea and solution of the defined problem (Design for Change). While there is a potential risk of a continuous communication of design thinking as a linear process model, there might be potential in reorienting the process and use systems thinking in the initial phases where the problem is identified and framed. Generally, these two phases are seen as first a divergent phase (research and identification of problems) followed by a convergent phase (framing the problem and creating the research question). With the experiences from the two educational projects discussed in this paper, we see a potential in providing the students with improved tools to identify places to intervene in a system. This will enable them to approach the system and thus the identified wicked problem, continually moving between ontological and operational perspectives.

In conclusion, the insight from this study points to a potential in reorienting the design thinking process by combining it with systems thinking.

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