CASE STUDY

Design thinking and shared ignorance as a framework for student-faculty partnerships: A case study of the creation of teaching activities for wicked problems

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ABSTRACT

This case study describes and discusses how student-faculty partnerships can be strengthened through design thinking and the establishment of shared ignorance, i.e., an awareness of how none of the involved parties understands the problem or knows the optimum solution of the partnership project. As a case, we use a student-faculty project that aimed to develop course material for an electrical engineering course based on project work involving wicked problems. This project illustrates, through student and faculty reflections, how design thinking and shared ignorance can be used to subvert implicit power structures and strengthen the partnership and project outcomes.

KEYWORDS

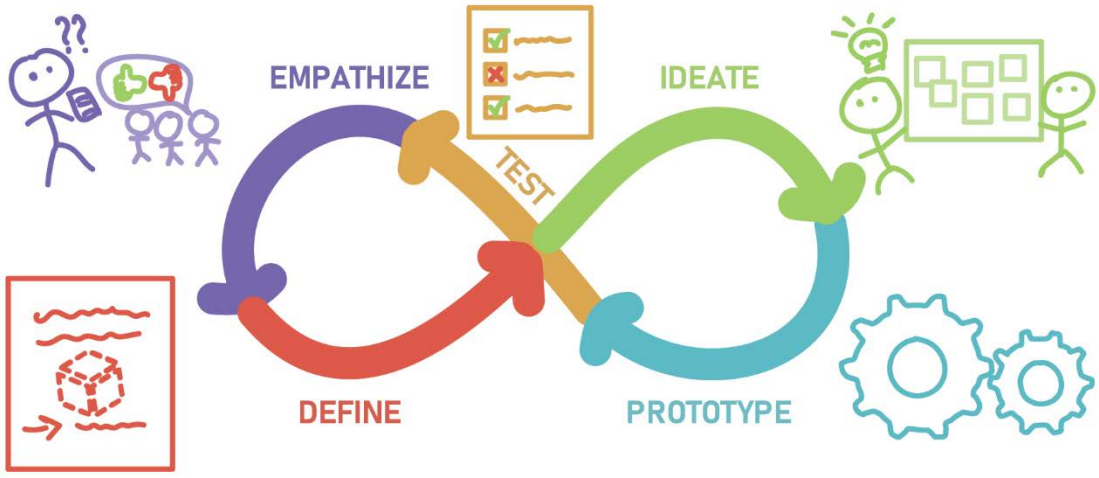
design thinking, wicked problems, co-creation, student-faculty partnership, power structures

Educational development projects often embody so-called wicked problems, or complex issues that defy simple solutions. Wicked problems are problems, usually social or cultural, that are difficult to define and solve due to their interconnected nature involving multiple stakeholders with different values and goals. There is no optimum solution that a participant, such as an educator, can prescribe for wicked problems. There is a collective lack of knowledge, a *shared ignorance*, of both the problem and the solution, requiring collaborative exploration.

Design thinking (DT) is a framework used to handle wicked problems that employs a human-centered approach to create solutions. This method involves understanding the user, identifying their problems, developing and prototyping proposals, testing these on real users, and iteratively improving the solution. DT is expressed as a five-step, iterative process (Lewrick et al., 2018): empathizing with the user, defining the problem, ideating solutions, prototyping solutions, and testing the prototyped solution, illustrated in Figure 1. Snelling et al. (2019) describe three cases where DT has been used in curriculum development by student-faculty partnerships. They found that the iterative nature of DT led to regular review, reflection, and revision, thereby strengthening the partnership. Through the design thinking process, the

partners' resistance to giving up control was reduced. They found resistance to giving up control especially prevalent while ideating, which could be mediated by starting the partnership with exercises lacking "right answers," and focusing on understanding and utilizing the partners differences of knowledge.

Figure 1: An overview of the iterative design thinking process



A key to this process is to assume a beginner's mindset (Lewrick et al., 2020), which involves questioning beliefs and the status quo to observe, listen, and discuss without judgement and to spark creativity. We contend in this case study that creating an awareness of educational problems as wicked problems, assuming a beginner's mindset, and embracing the shared ignorance of the problem through the DT framework mediates the barriers in a student-faculty partnership created by the power dynamics between and implicit roles of faculty and students.

SHARED IGNORANCE AS A DRIVER FOR PARTNERSHIPS

Ignorance in student-faculty partnerships serves as both a barrier and a positive catalyst for collaboration. Sophia Abbot's (2021) opinion piece, "The Role of Ignorance in Student-Faculty Partnerships," discusses this dual role, building on the work of Nancy Tuana (2006). Abbot differentiates between those whose knowledge is valued ("knowers") and those whose knowledge is not ("not-knowers"). Differences in valuation can act as a barrier for student-faculty partnerships by dismissing the perspectives and knowledge of the students by defining them as not-knowers. Abbot (2021) identifies a positive aspect of ignorance through how people of different social identities can acknowledge their ignorance of their differences, which allows them to arrive at a so-called "loving ignorance." Here, we aim to further explore ignorance as an enabler of partnerships.

Unequal valuation of competence in a partnership can create a dynamic where the knowers consciously or subconsciously dictate the direction. When one person provides the goals, methods, and workflow of the given project, it leaves the other participants passive and

without agency (Marquis et al., 2019; Matthews et al., 2018). Particularly, in a partnership of students and faculty working on educational development, the implicit power dynamics can lead the faculty, with their implicit status as knowers, to dominate and limit the potential of the partnership, despite conscious efforts to maintain equality. In this context, the barrier is not the ignorance of the students but the awareness of the implicit structures of the interaction. Additionally, expectations of faculty as knowers may further limit the project, as they may lack necessary insights into the educational problem, while students' lived experiences may provide essential perspectives.

Embracing differing knowledge in a partnership can become advantageous by leveraging differences in perspectives. For example, a novice's input may uncover areas where teaching is unclear (Burke, 2013). Being aware of how all participants can contribute is important for equal valuations of contributions and for challenging the implicit power structure (Cook-Sather et al., 2014). This awareness can be created by actively listening to the students and acknowledging them as experts at being college students (Mihans et al., 2008) or through renegotiating the power structure by adherence to the principles for student-faculty partnerships given by Cook-Sather et al. (2014): respect, reciprocity, and responsibility.

In this case study, we take a novel approach to renegotiating power dynamics by cultivating a shared space where no partners are experts. Recognizing that educational problems are often chaotic and with significant unknown factors, we advocate investigation of the problem and possible solutions together. We focus on ignorance not as differences in expertise or valuation of knowledge, but the shared ignorance of the input factors, output factors, and optimal methods of the project. We want to highlight how awareness of this shared ignorance, along with DT as a collaboration and exploration framework, can be used as a method of subverting power dynamics and can help to create an environment conducive to the principles noted above.

CASE CONTEXT AND BACKGROUND

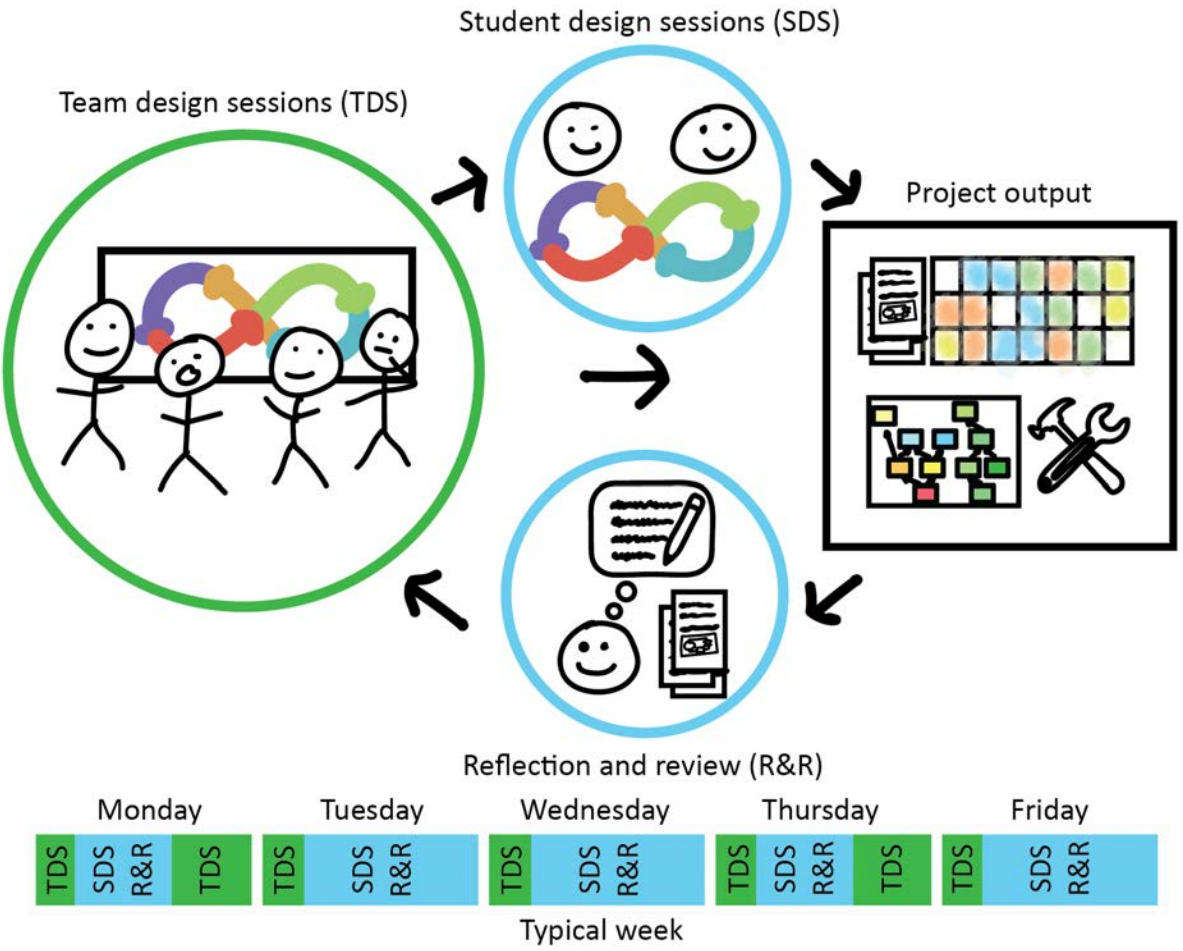
The context of this study is a first semester project-based learning course. The course is part of an electronic engineering program, Electronic Systems Design and Innovation, at the Norwegian University of Science and Technology (NTNU). Students work in groups to conceive, design, implement, and test a solution to a wicked problem provided by an external partner using DT and electronic systems. The semester is divided into two parts: the introductory weeks and the project. As this is a first semester course, the students do not necessarily have the knowledge of electronics needed to complete the project. Therefore, the first 3 weeks are dedicated to an introductory program where the students complete short electronics projects in groups to provide basic knowledge of relevant technical solutions. The rest of the semester is allocated to the students in groups making prototypes that should contribute to solving the problem given by the external partner (an overview of the course is given in Bolstad et al., 2021).

There have been significant challenges regarding both differences in knowledge between the students and a limited understanding of DT. The latter manifests as students largely understanding design as concerning outer appearance and therefore creating solutions with limited usefulness (Bolstad et al., 2021). Therefore, it was decided that the introductory weeks

should be redesigned to address challenges arising from differences of knowledge and to give the students the tools, motivation, and understanding to use DT in their projects.

To address the challenges of knowledge differences and unfamiliarity with DT, the co-authors of this article—two students (Ida Bjørnevik and Sven Amberg), a university lecturer (Anders Strømberg), and an associate professor (Torstein Bolstad)—initiated a summer project to remake the introductory weeks. The two students were hired to work 4 weeks full time to work on the project in addition to being hired as teaching assistants in the course the following Fall. Both had taken the course a previous year and were familiar with the course contents.

Figure 2: An overview of the partnership organization



ORGANIZATION OF THE PARTNERSHIP

The partnership was organized as illustrated in Figure 2, with the team design sessions as the central activity. There were shorter morning sessions and longer sessions. Outside of the

meetings, the students, as they were employed to work full time on this project, worked together in a shared office to further apply the DT process and gain knowledge and insight into the problems we were working on or to develop resources, learning activities, and plans based on the discussions in the meetings. The student design sessions were done with limited input from faculty. In parallel, the faculty reflected on and reviewed the output of the work to create a joint understanding of the progress of the project. This work served as input into the design sessions.

The design sessions were led by faculty who also set the overarching agenda for the meetings. The meetings were characterized as open, relatively unstructured and informal, and with significant use of whiteboards. The first meeting consisted of introducing DT as a framework for the project and the challenges that the faculty had observed as educators. In the subsequent meetings, preliminary output was discussed and DT tools were used to gain insight, ideate, or prototype together.

The output of the project was in the form of plans for the introductory weeks, modular exercises adapted to different levels of pre-knowledge, and design challenges combining electronics with the DT framework.

INVOLVING DESIGN THINKING IN THE PARTNERSHIP

At the initiation of the summer project, we recognized that designing the introductory weeks presented a wicked problem, much like the wicked problems given to the students in the course. Despite Torstein and Anders' previous experiences with education in general and this course in particular, we all lacked a clear understanding of several key aspects of the course: the student input factors, the desired student competence and attitude at the end of the introductory weeks, and the precise contents of these weeks. Given this complex problem, DT was chosen as a framework for the student-faculty collaboration. Our shared ignorance regarding optimal solutions provided a common ground for the partnership.

Starting from a point of shared ignorance and taking a beginner's mindset was seen to be important to give ownership of the project to the students as they would spend considerable time working on the project by themselves.

Introducing this framework was the most faculty-centric part of the partnership as Anders and Torstein had the most familiarity with DT and the course. To mitigate the power imbalance this created, we strongly emphasized a beginner's mindset and a shared ignorance. We explained that while there existed some idea of what the effects of the new introductory weeks should be, we were ignorant of how this could be accomplished, what the underlying issues were, what knowledge and goals the students had coming into the course, how they experienced participating in the course, how they could be given competence and motivation for DT, whether we were asking the right questions, and how we could work together to accomplish our project. Iterating through the DT process together could give us the insight to allow us to propose and create a satisfactory solution.

REFLECTIONS ON USING DESIGN THINKING AS A COLLABORATION TOOL

At the outset of the project, all participants were asked to continuously reflect upon the partnership and the project. After completing the project and in conjunction with the creation of this work, all participants individually reflected in writing, using questions inspired by Cook-Sather et al. (2019):

- What were the positive and frustrating experiences during this partnership?
- How did you experience using DT as a tool to facilitate our partnership?
- Do you feel that we started this partnership with a shared ignorance?
- How could we structure the work differently to a achieve better collaboration and partnership?
- How could we structure the work differently to achieve better project output?
- Faculty: What are the most important pedagogical insights gathered from this partnership?
- Students: How has this partnership affected your experience as a student?
- How did the students work on the introductory weeks in the course?
- Do you have advice for others that want to structure a similar pedagogical partnership based on DT?

From these self-reflections, joint texts were created from the parts that were found to be most relevant for this case study, creating reflections that were made to echo the individual experiences and to be recognizable by all participants. While acknowledging that the sample size in this work is limited, we will use this case study to suggest and critically reflect upon implications for similar partnerships.

Student reflections

We, as the two student partners involved in this project, found that using DT in this project has largely been a positive experience. Anders and Torstein had already defined an overarching goal; the rest was unknown and open for exploration. The DT framework encouraged us to explore creative new perspectives and ideas that we otherwise would not have engaged with. We felt a sense of autonomy and an absence of preconceived solutions. Emphasizing DT from the outset allowed us to adapt to changes and new ideas in the middle of the project, providing important structure to our work. We believe these factors culminated in a novel and substantially improved introductory weeks program.

However, the flexibility and the uncertainty intrinsic to the framework was also our partnership's biggest difficulty. Not knowing exactly what we should do, coupled with increased responsibility, sometimes made the task feel too big for us to handle.

We both felt that everyone started out this project with a shared ignorance of the problem and a beginner's mindset. The faculty knew more about the DT process but were otherwise just as ignorant as us students. We felt that they met us and our contributions on equal ground, boosting our confidence during the project. During the project, we were taken seriously

and our ideas were assessed and integrated in a good way. Everyone was an equal member of the team.

We were not intimately familiar with DT initially, but the introduction by Anders and Torstein built on our previous experiences and contextualized its use in this project. However, we could have wished for more information on the DT framework to get a better understanding of the relevant tools and procedures.

To improve the partnership further, we suggest more informal interactions such as lunches or casual meetings that could help us open up to each other or get our minds flowing together. In general, a closer collaboration would have been useful as it sometimes felt as we were working without a clear understanding of the goal, which could feel demoralizing. A closer collaboration would also help us prioritize our time better.

Participating in this project has given us new perspectives on our field of study and a deeper insight into DT. We have both utilized DT in problems, projects, and cases we have encountered after this partnership.

Faculty reflections

We embarked on this project with minimal planning before the students began their work, influenced by both time constraints and a desire to include the students in the processes. This spontaneous approach may have been a positive aspect of the collaboration as it made us more open to ideas and ideation without fixed expectations of what the result should be. It allowed us to take a beginner's mindset and to create a space with shared ignorance of what the final product of Ida and Sven's work should be.

Through the partnership with the students and using the DT framework, we got to experience the feeling of serendipity, stumbling onto good ideas and improving upon them. Through the meetings with the students, we were always left with a clear plan moving forward, plans we really believed in, even if we came into the meetings without a clear idea of where we were heading. We also experienced frustration as there was a lack of a schedule to stick to, creating uncertainty about whether this project would amount to anything worthwhile.

The DT framework and the established understanding of our shared ignorance became the anchor in this process and was the key to our positive experience of the partnership. DT gave us the courage to purposefully diverge in ideas and give the students equal or most of the responsibility for defining problems, goals, subgoals and solutions, instead of using established solutions for Ida and Sven to implement.

To improve the partnership, we believe that we could have used the tools of DT even more purposefully, for example by using ideation techniques that could have generated more creative solutions. Establishing a shared vocabulary and a better foundation in DT would have helped in this process. Additionally, we believe that we could have improved the results by giving more time to testing and doing more development iterations.

We have through this project come to appreciate how useful it is to trust the students and level oneself with them, creating shared perspectives and conceptions. Not assuming or forcing a certain outcome but being open to new ways of solving problems was the key to the success of this project.

INSIGHTS AND TRANSFERABLE LESSONS

In summary, using DT and establishing a starting point of shared ignorance was experienced by both students and faculty as useful for establishing an equal, creative, and productive partnership. The main points for improvement were to create more meeting points, formal and informal, and a more thorough introduction to and deliberate use of the DT framework. The reflections reveal that although creating a space of shared ignorance gave the students ownership, it also created insecurity. While the faculty's ignorance centered on the input and output of the project, the students also experienced ignorance around the tools and process, which might have been mitigated by closer collaboration. This difference in perceived ignorance should be a point of attention to similar partnerships.

Returning to the three guiding principles of Cook-Sather et al. (2014) of respect, reciprocity, and responsibility, we believe from our lived experience that using DT, adopting a beginner's mindset, and explicitly creating awareness of a shared ignorance will strengthen all these principles in a student-faculty partnership. Respect is taking seriously and valuing what others bring to the partnership. DT requires an openness to new ideas and an appreciation of the perspectives and experiences of others through empathizing with them. Furthermore, awareness of a shared ignorance allows for the creation of reciprocity through allowing everyone to contribute with a more even power structure. Finally, having a framework where gaining understanding and then creating solutions is central creates responsibility for the participants and allows the students to take part in the entire process.

While Snelling et al. (2019) found that using the DT framework was a suitable foundation for building an equitable partnership, they also saw that at certain points in the process it was difficult for teachers to divest some of their control. We find that emphasizing shared ignorance as a common starting ground reduces this challenge. Likewise, we also found that using DT created ownership and recognition of everyone's contributions. Expanding on Snelling's experience of the ideate stage as important for renegotiation of power, we highlight here the empathize stage as equally important for creating equality in a partnership.

Using DT in the context discussed here, that is, with engineering students, might be easier than in some other contexts as the students are familiar with employing methods and techniques for solving problems and are comfortable working within set frameworks. Additionally, these students had some prior experience with DT which made the utilization of the framework easier. However, students from other fields, such as the humanities, might have other advantages over engineering students, for example being more comfortable with wicked problems or more experienced with methods for gaining insights and questioning previously held beliefs and assumptions.

In conclusion, in this case study we have found from our lived experience that explicitly creating an awareness of a shared ignorance and using DT to move forward from that shared ignorance can be a driver of student-faculty partnerships and a useful way of reducing power imbalances.

NOTE ON CONTRIBUTORS

Torstein Bolstad *is an Associate Professor and Deputy Head of Department responsible for education at the Department of Electronic Systems at the Norwegian University of Science and Technology. He has an PhD in nanoelectronics and is currently focused on developing and researching engineering education. His interests include education for sustainability, development of non-technical competences, and development of student culture and mindsets.*

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