

Fostering Creative Confidence with SCD in Interaction Design Education

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Abstract. Creative confidence is a concept that has been popularly linked to design thinking in more generalist interaction design education. Based on an analysis of creative confidence, however, we propose that Speculative and Critical Design practices (SCD) can be a better perspective for developing creative confidence in aspiring designers. We present how we have taught two subsequent SCD courses as part of a short 2-year generalist interaction design master's programme. Based on the outcome of selected student projects, course evaluations, and personal reflections, we articulate the promises and pitfalls of using SCD to foster creative confidence.

Keywords: Design, education, interaction design, speculative and critical design, creative confidence, creative self-image, creative self-beliefs

1 Introduction

As design educators in an MSc-level interaction design programme, we often find that it can be difficult to foster creative confidence among students. Students who are new to design find that the nonlinear path of engaging with multifaceted design problems can sometimes be alienating or confusing. This challenge stems partially from the fragmented nature of interaction design. Interaction design is concerned with constructing and developing digital products and systems [1], with an intellectual tradition that is composed from various disciplines. Sharp, Preece and Rogers [2] famously illustrated how interaction design, with its strong relation to HCI, is academically related to the social sciences, computer science, engineering, informatics, psychology, and ergonomics, with related practices in graphic design, product design, industrial design and the arts. From this perspective, interaction design is a “glue” discipline, linking many different fields together in a common pursuit—developing compelling expressions from emerging computational materials [3, 4].

With interaction design having its roots in so many intellectual traditions and disciplines, educating interaction designers is therefore foremost about facilitating the development of a general set of skills, knowledge, and competences, and synthesizing them into a meaningful whole. Of course, a designer develops her ability within existing institutional traditions [5] that result in different specialisations within the discipline—for example connecting interaction design to ethnography, innovation, technology, craft, or management. In all of these cases, though, educating interaction designers

implies educating designers with a generalist profile: designers should be able to be creative as well as analytical, exercise critical judgement, communicate with various stakeholders, be familiar with technology and materials, values and ideals, and have the ability to compose all of these, making something whole from knowledge and information from the smaller parts [1]. By bringing these different skills together and basing them in any number of existing disciplines and professions, interaction design offers an opportunity for students from a wide range of diverse backgrounds to enter the design field.

Due to this broad range of abilities and knowledge, it can be challenging for interaction design education to foster creative confidence among students, especially for those new to design. By “creative confidence in design” we mean that our students should learn how to work comfortably within a design problem and develop the sense that design is a medium for inquiry and self-expression—leading to self-assured design activity in the future. This idea comes from creativity researchers Karwowski and Beghetto, who describe “creative confidence” more specifically as *the belief in one’s ability to think or act creatively in and across particular performance domains* [6]. Students who are confident in design can be comfortable in unknown design situations, integrating bits and pieces of research and insight as part of what Kolko calls an abductive design process [7].

So far, developing creative confidence in design has been primarily linked to design thinking, in particular by the design consultancy IDEO [8, 9]. Design thinking claims to offer perspectives on design and a strong method that can consistently lead to innovative ideas and through trust and faith in that method thereby grow a designer’s creative confidence [10]. We argue that this kind of creative confidence is limited to a confidence in *method*, detached from individual skill and expression. Instead, we propose that by incorporating a speculative and critical design (SCD) perspective in interaction design programmes, educators can foster richer creative confidence among students in *design* by allowing for deeper engagement with design itself through the open-ended exploration of a topic and imagining different worlds for design materials to take part in.

This article first elaborates on the notion of creative confidence, both in terms of its popular understanding as well as current academic perspective and use. We then present how design has already been related to creative confidence via the idea of design thinking. This is followed by an account of SCD as developing a different kind of creative confidence in design students. To illustrate this, we describe two courses that are part of our design education that use SCD methods and techniques. Drawing from students’ project outcomes in those courses, our own reflections as course staff, and from course evaluations, we outline a set of promises and pitfalls for how we believe SCD can contribute to developing creative confidence among interaction design students as part of a generalist design education.

2 Background

This background section is presented in three parts. First, we unpack academic understandings of “creative confidence” to build an understanding of foundational

attributes of self-concept and self-efficacy. Second, we build on these to understand how design education has already been claimed to develop creative confidence. Finally, we argue why we feel that speculative and critical design offers an opportunity to build richer creative confidence in practice.

2.1 Creative Confidence

Individuals who believe that they can effect change are more likely to achieve what they set out to do [11]. Broadly, this belief in one one's ability to create is called *creative confidence*. Within design and innovation, this idea has been popularised by IDEO's Tom and David Kelley in the book named *Creative confidence: unleashing the creative potential within us all* [9]. For educations that attempt to produce professional designers, we see creative confidence as a key skill to be nurtured and expected among graduates.

Educating students to have this creative confidence means to develop designers who believe in their ability to use design to effect change. Following Kelley and Kelley [9], creative confidence is crucial for a design discipline as it helps to develop persistence towards accomplishing goals, being resilient in the face of failure, and transcending fears that block creativity (p65). Creative confidence is an inherently optimistic way of looking for what is possible (ibid, p42), a willingness to go wide when faced with open ended questions (ibid, p59), a belief that skills are not set in stone (ibid, p59), and an attempt to improve the status quo (ibid, p63).

This popular idea of creative confidence has recently become a subject of increased academic study. Researchers such as Karwowski and Beghetto mentioned above have defined creative confidence as "the belief in one's ability to think or act creatively in and across particular performance domains" [6]. The idea of creative confidence in this domain expands to a broader set of creative self-beliefs [12]. In this model (Table 1, below) the idea of *creative confidence* is composed of *creative self-efficacy* and *creative self-concept*. Creative self-concept is a judgment of one's creative ability across domains and is measured by statements like 'I am generally good with coming up with new ideas.' In this component of creative confidence, prior experiences shape a person's perception of their ability. Creative self-efficacy is the perceived confidence to perform creatively on a *particular* task and refers to statements such as 'I am able to generate creative solutions for this particular problem'. Creative self-efficacy will change and grow over time as a learner's familiarity with a specific task develops. In general, the more stable one's self-belief is, the more significant its role is in predicting pre-task creative confidence beliefs. Likewise, previous experiences, including actions that were performed moments earlier, and social persuasion influence confidence beliefs [11, 12].

Two other relevant concepts related to creative self-belief are *creative behaviour* and *creative self-awareness*. Creative behaviour is posited as the observable realization of creative potential [12, p. 406] and is deeply affected by creative self-beliefs [13]. For example, indicators of creative behaviour are the achievements, performances and artefacts that can be observed. This is especially relevant for design education, as creative behaviour results in design materials. Creative self-awareness refers to beliefs about the nature of one's creative abilities [12, p. 401]. This includes ideas of creative

metacognition—or when, how, and why to be creative, as well as a creative mindset, or how a particular person understands the nature of creativity and creative practice, for example whether creativity is innate or whether creative competence can grow.

Table 1. Creative self-beliefs (Adapted from [12]).

<i>Category</i>	<i>Specific Types</i>
<p>Creative Confidence <i>Beliefs in one's ability to think or act creatively in and across particular performance domains.</i></p>	<p>Creative Self-Efficacy <i>Perceived confidence to creatively perform a given task, in a specific context, at a particular level.</i></p> <p>Creative Self-Concept <i>Holistic cognitive and affective judgements of creative ability in and across particular domains.</i></p>
<p>Creative Self-Awareness <i>Beliefs about one's creative strengths and limitations and beliefs about the nature of one's creative abilities</i></p>	<p>Creative Metacognition <i>A combination of self-knowledge (i.e., belief about one's creative strengths and weaknesses) and contextual knowledge (i.e., beliefs about when, why, and how to be creative).</i></p> <p>Creative Mindset <i>Beliefs about the nature of creativity itself (e.g., is creative competence fixed, incremental, or both).</i></p>

In Table 1, we can see that creative self-awareness and creative confidence operate as part of an overall set of creative self-beliefs that each shape how a person understands their creative practice. Creative self-awareness beliefs are less oriented towards any specific task, but rather towards understanding and assessing one's own creative ability in general. This is relevant for design education, and particularly for SCD education—to be aware of one's creative boundaries and likewise the creative boundaries related to a design space. This perspective on creative confidence in design reveals that it is more than just the creative confidence above, but also requires creative self-awareness: it is a combination of how a person understands their own abilities (creative self-efficacy), how they see themselves as someone who can do creative things (creative self-concept), how that person knows when and why to be creative (creative metacognition) and includes their assessment of what kinds of people can be creative (a creative mindset)—all combining to become creative behaviour in practice. This expanding of creative confidence points towards a broader set of ideas to consider when imagining design education. The goal of this reframing is to produce a designer who sets their own agenda, understands when design is and is not appropriate, feels capable and

empowered to do design when it is appropriate, and engages richly with a problem—in other words, a creatively confident designer.

2.2 Creative confidence in design education

It is clear that the concept of creative confidence is a natural fit for design education. Making students more comfortable and capable in their creative process is ultimately the goal of any design instruction. Perhaps due to the popularization of the term by principals at IDEO, relating building creative confidence as part of a design-oriented education in the literature primarily refers to how design thinking can build that confidence (e.g. [9, 10, 14, 15]). Broadly, “design thinking” refers to a systematised version of how a designer imagines and engages with their work. It distils the creative process to a set of five phases that offer a schematic outline of how designers approach a problem, and through that thinking create innovative or novel solutions to them [16]. Through the stages of *Empathising*, *Defining*, *Ideating*, *Prototyping* and *Evaluating*, students are meant to learn how to approach a problem and imagine possible solutions for it.

In terms of design thinking as building creative confidence through education, Rauth et al. argue that design thinking forms creative confidence as part of an overall creative mindset that is developed by repeatedly experiencing and applying the design thinking process to given problems and thereby developing behavioural patterns that are useful in particular design situations [14]. These mindsets, based on familiarity with the methodological process, become foundational for creative development, as claimed by Groeger [10]. Here, design thinking expands into being a cognitive style, a general theory of design, an organisational resource [17] or a form of practice, thinking style and mentality [18], eventually cohering in the goal of fostering a “DT mindset” that is itself measurable [19] and reflects a new orientation to problem solving and finding innovative solutions that could ostensibly better prepare students for changing social conditions—such as the future of work, for example [10].

The broad applicability and shifting contexts for using design thinking, especially into domains beyond design as such have led to a number of criticisms, reflecting a fear that it has become unmoored from design practice [20–22]. For example, Kolko’s historical reflection on the origins of design thinking [20] casts it as a means of both abstracting and paying homage to the design traditions that inspire it. Kolko traces “empathising” to the participatory design practices developed by Pelle Ehn (among others) as a way to seriously and deeply engage users and other stakeholders invested in a design’s eventual context of use [23]. Likewise, the “defining” and “ideation” phases, phases of exploring a problem and articulating possible solutions, build on Simon’s ideas of design as operating within bounded rationality [24], techniques like Osborn’s brainstorming [25], modes of ideation like de Bono’s vertical and lateral thinking [26], and Schön’s conception of reflective practice [27]. These rich, careful methods become shadows of themselves as part of a design thinking process, buzzwords to invoke as part of a means of rationalizing a quick-and-dirty project by stepping through a set of phases intended to rapidly lead to innovative ideas, products, and services.

The main concern, however, is that too often *design* is left out of the frame—that design thinking methods engage at the surface level to generate novelty or innovative framings with neither contextual nor formal depth [19]—resulting in what Pentagram partner Natasha Jen has called “bullshit” [22]. Instead of the politically motivated engagement with real-world users of Pelle Ehn, design thinking uses rapid ethnographies meant to quickly generate user insights; instead of hours spent in the studio in conversation with material giving form to ideas, ideas are themselves the outcome. This iteration of design thinking as purely thinking about design has become a stalwart at courses in business schools and this work is published mainly in management journals, rather than at venues more focused on design or creativity as such. Ultimately, design thinking too often strips away the design *doing*, turning an approach for thinking through a problem richly into a kind of meditation on process or saleability [20].

In our view, the combination of building empathy, exploring a problem, and prototyping and testing a solution certainly comprises design thinking. But—after Tonkinwise [28]—it is also just design! The processual emphasis of design thinking, its linearity, the faith in its method and tools, the obsession with value creation, and the lack of engagement with form-giving and materiality does not truly push at the boundaries of what is possible, does not engage seriously with open ended questions, does not challenge a student’s capacity to develop new skills and insight, and ultimately is not meant to develop a multifaceted understanding of the complexities of the status quo. To use the framing from the previous section, the methods-based approach could lead to creative confidence but does not couple to that confidence richer creative self-awareness. Surely, creative confidence can be found in the protocol and in the methods, but the confidence that students find there is limited to precisely those.

While design thinking offers scaffolding for those new to design to understand an archetypal design process and engage in design activity, we feel that the process on its own does not offer the kind of engagement with the content, form, and depth of design practice to help develop a designerly approach to engaging with open-ended or incomplete problems, of taking on an authorial role in design, and of engaging more broadly with the future. Here, we feel that speculative and critical design offers a way to build that creative self-awareness, and develop creative confidence in *design*, and not simply confidence in *method*.

2.3 The potential of SCD education to foster creative confidence

To shift our understanding from how creative confidence applies to design as scaffolded by design thinking towards its possible scaffolding by speculative and critical approaches, we need to articulate more precisely what we mean when we say SCD. Fundamentally, speculative and critical design (SCD) is a design practice that is rooted in contemporary life but is about the world of the future. In this way, it is a kind of design practice that is as about inquiring into a setting or condition as much as it is about producing a product or service [29]. A speculative practice in design inspires thinking, raises awareness, examines, provokes actions, opens discussion, and intends to provide alternatives to the status quo.

Unlike commercial design practice, SCD takes design as a medium to challenge contemporary issues. It positions design as capable of more than products or market solutions, instead imagining and demonstrating new relationships within a culture permeated by technology. While SCD creates prototypes that can be interpreted as products, these products are not the only thing that SCD creates—SCD is used as a basis for cultural criticism [30, 31], for politics [32], for imagining diverse futures [33–35], and for sustainability [35–37]. Mitrovic et al. describe speculative design practice as, above all an, an attitude—an approach open to various methods, tools, techniques and instruments that also is free to incorporate ideas and agendas from other practices and disciplines [38]. Like [2], we can understand SCD as also being a kind of "glue discipline," assembling perspectives and qualities from many different fields to offer new perspectives on emerging and future problems. In this vein, [38] goes on to describe a "fundamental openness" to speculative design, in that it "is characterised by not belonging only to the design context and a particular set of rules or methods." This flexibility stands in stark contrast to how we see design thinking, where this rich, multi- and inter-disciplinary approach is flattened to become mostly about process.

We feel that involving students in speculative and critical design experiments gives them the ability to see a problem as more completely their own. After Tharp and Tharp [39], critical and speculative practices in design offer a means of creating design that is discursive, or meant to foster storytelling in what a design problem is, what a design artifact does in the world, and why it is important that a design does that thing. Fundamentally, it enjoins designers to become active participants in constructing new understandings and meanings for emerging computational systems, technologies, and the conceptual frameworks that motivate them [40, 41]. At the same time, it places a responsibility on them to not take what is sometimes infrastructural or foundational as invisible or always-stable, especially when envisioning future worlds that challenge current norms, assumptions, and values [42, 43]. While SCD has been criticised for being too often rooted in images of the future that are not critical enough [44], or in imagining "provocative" dystopias that merely recapitulate situations that many marginalized people already live in (in the comments of [45]), SCD is fundamentally embedded in a discursive mode that intends to question the status quo.

This participation in design as discourse provides a distinct and pedagogically valuable difference from design thinking. Too often, design thinking methods focus on problematizing the current world to let designers take on the familiar role of a problem solver to create value. At its core, SCD offers a means of letting students move away from being a problem solver, instead moving towards design as an avenue to highlight and understand social concerns. Rather than trying to develop novel applications for peoples' existing practices, SCD is driven by a desire to explore emerging technological possibilities and their concomitant emerging socio-cultural developments [40, 42]. By removing constraints that come from the commercial sector that defines a standard design process—design thinking—SCD uses prototyping as the heart of a design-based process of inquiry that creates fictions to speculate on alternative products, systems, or worlds [31]. This leads to mandates for students to imagine settings for design that are highly conceptual, open-ended, reliant on strong framing, and requires the capacity to see and imagine an issue from many different points of view, asking students to become the conceptual authors of their designed worlds.

We believe that a design education including SCD methods can better foster creative confidence among students by creating a fundamental orientation towards doing design as a mode of inquiry. Particularly as part of our generalist design education (described in greater detail below), acts of design are inherently more conceptually orientated and require outlining a meaningful problem space for design to operate within. SCD can help push these boundaries, and in doing so, support students' abilities to articulate a problem and develop a conceptually challenging proposal. We believe that a student who can articulate and argue for a design that is based in a discursive context is a student who is well-prepared to engage with more standard user-centred practices.

The rest of this paper argues for the development of these abilities from educators' perspectives on two design education courses in a masters' programme in digital design. We offer a post-hoc analysis based on our own reflections, student project development and outcomes, and student evaluations. Our case studies discuss how course design and activities contribute to developing creative confidence and reflect on what has been successful and unsuccessful when teaching. We use projects from each course to illustrate what kinds of design materials the courses have produced, linking them to both course goals and broader topics of design education. This means that the course design is the main way we can talk about how creative confidence is meant to be formed and why course activities contribute to the broader definition of creative confidence. We illustrate this with projects from the course and use course evaluations and teaching reflections to analyse whether the courses have been successful. We therefore do not intend to present highly valid and broadly generalizable results, but instead a set of grounded reflections and perspectives to hopefully open a conversation with other design instructors.

3. Case Studies: SCD in an interaction design education

This section presents two courses that are part of a 2-year MSc programme on digital design at a university that aspires to create value with information technology. The programme enrolls approximately 120 students each year, bringing together students from a variety of backgrounds. Most students in this program have backgrounds that are oriented towards digital design, such as interaction design, product design or computing, but students also enter from anthropology, business, innovation and marketing, journalism, communication, and computer science. The courses in our design programme relate to one of four categories: interactive technology; design theory, methods, and concepts; data and analysis; or business and innovation. These categories provide an exposure to relevant but wide range of areas within digital design, and the programme is designed to highlight the connections between them. In the first year of the programme, all areas are covered somewhat evenly. In their second year, students choose to focus on one topic as a specialisation in interaction design, user experience design, service design, or user research.

Given the variety of enrolled students, the digital orientation within interaction design, the coverage of the four different areas in the curriculum, and the relatively short duration of study, the programme tends to produce digital designers with a broad and general skill set that is coloured by their specialisation. In terms of employment

profiles, graduates become employed in a broad range of areas where confidence in creative production is essential, especially when their background is not already strongly academic, design, or technology oriented. This paper traces two design courses that use critical and speculative design approaches—implicitly or explicitly—as part of the course plan and reflects on how they contribute to developing creative confidence in students.

The first of these courses was a mandatory course in the Spring semester of 2019, and the second was a specialisation course in interaction design taking place in Autumn 2019 and 2020. In this article we use the first course to offer insight on how the widest possible net of students understand speculative methods and take them up as part of their design practice, while we use the second to see how fluency or confidence developed from the first course becomes put into practice. Taken as reflective case studies [46, 47], we describe the courses' structure, literature, and goals, and reflect on what has been successful and unsuccessful in each. Table 2 serves as an initial comparison on how SCD was treated in the respective courses.

Table 2: Comparison of the two SCD courses

	2nd semester course 'Experimental Design in Practice'	3rd semester course 'Situating Interactions'
Class size	~ 120 (30 groups)	~ 40 (10 groups)
Mode of teaching	Lecture based	Lecture and studio based
Academic content	Ubiquitous computing, SCD	Research through design, prototyping
Deliverable and evaluation	Video, props, report	Refined prototype, images, poster, narrative, pictorial
Design outcome	Concept focused	Concept and material focused
Topics	Health, Agriculture, Education, Leisure, Economy, Mobility, Safety, Domesticity, Spirituality, Public space	Future domestic life, food systems
Primary methods	Narrative writing, video prototyping	Research through design, prototyping
Framing	Explicitly towards SCD	RtD, implicitly towards SCD

In our account of these courses, we rely on three different sources. First, students' design projects provide an account of the *creative behaviour* of students. Second, the evaluations of the course that were taken in the last two weeks of the course, to illustrate students' self-reported creative development and experiences, and through that their creative *self-concept* and *creative metacognition*. Finally, our own reflections on how we have seen students struggle and grow creatively, linking to their ideas of *creative self-efficacy* and *creative mindset*. For each course, we reflect on how the course structure and feedback supports developing aspects of creative self-awareness as well as creative confidence via SCD.

It should be noted that this qualitative and reflective perspective is not a standard approach to assessing creative confidence. Most often, questionnaires and scales such as the 'Short Scale of Creative Self' [48], or the 'Creative Achievement Questionnaire' [49] are employed to provide measurable outcomes as a way to operationalize and to assess creative self-concept. These research contributions tend to be in structured studies for dedicated journals on creativity research. In this paper, instead, we present a post-hoc analysis based on the different sources above. While this means that our findings are certainly not representative and cannot be extended to other courses and contexts, we feel that they are broadly indicative of how SCD methods can play a role in developing creative confidence among students.

3.1 Experimental Design in Practice

Experimental design in practice was a semester-long course that aimed to develop students' knowledge of and competence in ubiquitous computing and SCD, and to use that knowledge to develop speculative designs that illustrate ubiquitous computing futures. Accordingly, the course was broken into two parts: one covering ubiquitous computing, and one covering SCD.

The first part on ubiquitous computing was based on four lectures. The first was about ubiquitous computing's vision and academic impact, the second on its networked systems and technologies, the third on context awareness and location-based systems, and the fourth on privacy implications of the above. These lectures were intended to provide a solid theoretical base in historical developments in ubicomp and related issues and concerns, while drawing connections to more recent concepts such as the Internet of Things, the smart home, machine learning, and artificial intelligence. Course literature came from a textbook on the fundamentals of ubiquitous computing [50], and was supplemented by additional relevant literature (e.g. [51–53]).

The second part of the course consisted of three lectures on speculative and critical design, design fiction, and SCD practices in industry. These were used to introduce students to the fundamentals of SCD practices and draw out the characteristics that they share in terms of how they operate. Supporting literature came from Dunne and Raby's *Speculative Everything* [40], with supplemental readings on speculative design [31], design fiction [54–56] and commercial takes on design futures (e.g. [57]).

Course Structure. The course was centred around one large, explicitly SCD project where students were asked to speculate on ubiquitous computing futures within a domain: health, agriculture, education, leisure, economy, mobility, safety, domesticity,

spirituality, and public space. The class was comprised of 30 groups of 4 students, and approximately three groups worked with each domain. The aim of the course was to produce a short film (2-3 minutes) depicting a design future presented as part of everyday life, inspired by [58–61]. The film format was chosen to lower the skill threshold necessary when compared to a physical prototype to turn the focus towards concept development and storytelling.

Besides the academic lectures, the course included a series of exercises to support the development of the design proposals. Due to the size of the course, the number of groups, and the different domains under discussion, these exercises were relatively structured with well-defined and concrete goals for students.

Building domain knowledge. First, students were asked to create a timeline depicting technological advancements in their domain, including short descriptions of how these advances influenced existing human practices, how they enabled new practices, and how they challenged and changed relations between people. This was meant to create an initial familiarity with the domain, articulate historical socio-technical developments within that domain, and develop a sense for related matters of concern that could become a design opportunity, in the process developing the discursive qualities that SCD is known for.

After creating this timeline, students were asked to explore contemporary technological developments in the domain, including academic as well as industrial examples. This desk research led to a collection of A5-sized cards, each describing and depicting a particular technology in the domain. The historical timelines and current technological developments were brought together with the other groups working in the same area to sketch out a set of issues and concerns as possible topics of interest to design for. Students were meant to include anticipated direct or indirect social consequences of the identified trajectories for these domains, laying the foundation for SCD design directions that were discussed at a mid-semester critique session.

Developing design concepts. A second collection of exercises intended to support ideation and concept development. In this phase, members of a group would each individually write a narrative around a possible technological application within the domain, including people's aims, relations, and technology use inspired by Blythe [62]. These individual narratives became starting points for developing imagined worlds. The narratives and world combined would be used to identify qualities of stories that could make apparent the possible consequences of technological application. This would eventually lead to a storyboard and script for the film, after Oogjes [63].

Upon completion of the exercises, the course transitioned more actively into project work. In this phase, the groups constructed props and developed storyboards for their films that were discussed at a second critique session. The course concluded with a film festival at our institution showing all 30 films.

Project outcomes. This section presents the outcomes of three student projects from Experimental Design in Practice. These projects were selected to illustrate different topics from the course, as well as represent the overall character of the films that resulted from this course.



Fig. 1. Snapshots from the Film ‘Smart Crops’.

Smart Crops was developed in the domain of *agriculture* and imagines a future in which farmers will be able to control and monitor their fields through Technologically Modified Organisms (TMO—after GMO). These TMOs are portrayed through the use of a “black box” [64] that communicates with a shepherd plant that, in turn, instructs surrounding plants through chemical compounds using nanobionics [65]. The system illustrates a transformation of farming as well as the role of a farmer, who would largely be able to control and follow the development of their fields from a distance computationally.

The short film is an adaptation of a well-known national TV show about farmers seeking romantic partners. In the film, the speculative technology is integrated into the script discreetly, as the show interviews the farmer Ruud about his life and perspective on love. Ruud describes how he runs his farm using Smart Crops, and how that changed his farming practice. Smart Crops have enabled him to have more time for hobbies and has correspondingly affected Ruud’s free time as well as what he seeks in a relationship.



Fig. 2. Stills from *Happy Ever After with Data Donation*

Happy Ever After with Data Donation was developed within the topic of *domesticity*. It imagines a future where the loneliness of a widow or widower could be reduced through the data-donation of their deceased loved ones. Inspired by current practices of organ donation, data donation is organised by the Centre of Data Collection that uses AI on voice, text, and historical social media data to recreate someone's voice and personality. The donated data can be integrated into a variety of smart objects that each allow a widow or widower to live as if the deceased partner was present in a picture frame, urn, lamp, or eyeglasses, and reincarnated as a smart home assistant—functioning as both a smart object to help with daily tasks as well as a conversation partner. The short film depicts potential consequences of living with the smart picture frame, considering what it means to be lonely or together, the role of technology in grievance, the afterlife of personal data, and commercial practices around data.

The video follows John, who lost his wife, Elisabeth. John seeks out the Danish Centre of Data Donation seeking to revive his wife. A saleswoman from the company presents different products and subscription options. John receives the smart picture frame, and depicts three days of them being together, including a conversation during

breakfast interrupted by commercials; how the frame helps John with crosswords; and how the frame helps to purchase John's favourite food. The film ends with the frame anxiously asking for John to return when he is briefly out of sight.



Fig. 3. Stills from *The Spunk*

The Spunk was developed within the topic of *health* and imagines how technology can support families in the precarious emotional period when a baby is born prematurely. Spunk is a telepresence object for parents who cannot stay with their premature babies at the hospital that transmits the baby's heartbeat and smell, while representing the baby's growth. The short film depicts potential consequences of temporarily living with a personal and intimate telepresence object and addresses what it means to bond with a child and how technology can play a role in this situation. Fundamentally, it asks what meaningful technologically mediated attachments could be like in the future.

The story presents a young couple who just had their first child. The child is born prematurely and needs to stay in the hospital for some time. The doctor presents them with Spunk and instructs them how to use it. The distressed couple are perturbed but leaving their baby in the hospital, take Spunk home. While ignored at first, they bond

with Spunk, and it becomes a part of their everyday life. When they return to the hospital, the couple exchanges the proxy for their healthy baby, see it go into the hands of another parent, and feel a pang of loss and longing.

These videos showed creative behaviour in practice and developing them required a certain level of creative confidence. The videos had well-developed storylines, the projects exhibited a sense of authorship by the students, and ultimately each of them moved from an open-ended starting point to a level of form and depth that brought to the foreground a complex set of issues that could plausibly emerge around a particular technological development in various application domains.

Evaluations and reflections. A university-required evaluation questionnaire (with approximately 40% participation) showed that the course was generally well-received (scoring 5.09 on a scale of 6). Nevertheless, the detailed course comments showed that the course catered to some students more than it did to others. Students attributed this to the relevance of the course considering the overall programme, but they also found engaging with SCD time-consuming.

In terms of relevance, some students appreciated the conceptual character of the course; its creative freedom (*'I like that the course had room for creativity', 'I think it is good with an out-of-the-box task', or 'this course has been a design-playground for me. It is refreshing to let creativity and weird ideas flow freely'*); and that it was set outside of commercial constraints (*'great to be free of business stuff', or 'it is so nice to finally get to work outside of industry/business constraints! Love it!'*). Others found it difficult to see the direct relevance for their future job profile and would like to see a stronger focus on actual development of technology (*I will never use any of the knowledge gained in this course or 'it took a while to figure out the purpose of the course'*). Still, the term “creative” in one form or another appeared in half of the approximately 80 qualitative comments to the question ‘this was good about the course, highlighting it as a factor of the course that strongly affected the experience of the students.

Given the emphasis on written reports as main deliverables throughout the masters’ programme, the nature of the video as course deliverables was appreciated as a format that better recognised an act of design. However, some found the video too time-consuming, and would like to see more support in making videos (*'the exam form is centred on making a "pitch-movie"—something that we have never been taught or fits with the study line. Seems a bit out of place'*). Video is a format that requires skill and time, and it certainly not clear how much the skill of video production and editing should be emphasised in a program such as ours. At the same time, video is a useful design material for representing futures: it can convey strong stories that are almost seductive in representational quality and verisimilitude, but reaching that level requires a strong aesthetic sense and vivid authorial intent.

What was especially striking in the evaluation, though, were the responses to regarding whether a course like this should be mandatory or an elective. This resulted in a nearly uniform distribution (Figure 6, at the bottom), meaning that the kind of work done by SCD was not necessarily regarded by students as an intrinsically essential component of their generalist design education. Here, again, relevance to an eventual employment profile seemed to be at stake (*'this course should have been an elective. The philosophy is valuable to me as a designer, but otherwise it seems like a course for*

people who aspire to work in the field of arts'). Despite some scepticism about the broader applicability of the material, the results show that the course was generally liked and students found that the material was interesting and useful, as both scored more than 3.4 out of a scale of 5.

Learnings and preferences

Mentimeter

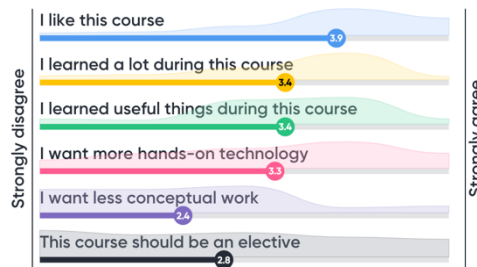


Fig. 4. Outcome of an in-class questionnaire with 52 participants. Note the uniform distribution of responses to the question asking whether this course should be an elective.

As a mandatory course for a large cohort, this course was an attempt to introduce SCD and enable students to engage with its content and form in a structured way to develop a designerly approach to articulate issues in particular domains. With the emphasis from this course being on storytelling in both the exercises and video deliverable, the students generally took on an authorial role in engaging with the future. Of course, the students worked in groups, which inherently makes it hard to judge the development of creative abilities in the individual student. Nonetheless, we have seen how students overcame some of their initial hindrances towards a design practice that was regarded not being about ‘real-life’ issues. It resulted in creative behaviour that, combined with the course evaluations, support the idea that the course fostered the development of creative self-efficacy and self-concept—what [12] consider the foundations of “creative confidence.” However, student feedback from this course indicated that it wasn’t always clear why this course was required and what relevance it had to their broader programme of study. Here we see possible a gap in terms of developing qualities of creative self-awareness, particularly the metacognitive understanding of why this creative act matters and whether this kind of creativity is meaningful.

3.2 Situating Interactions

Situating interactions is part of the specialisation in interaction design within our MSc programme. It is the second in a series of two courses in interaction design, taught to a subset of students in the programme who are especially interested in developing technologies. In the first course, “Designing Interactions” (which runs in parallel to “Experimental Design in Practice”), students are introduced to different prototyping

environments to develop skills in making with different technologies and tools while responding to a variety of project briefs. Situating Interactions builds on this breadth with an in-depth project over the course of the subsequent semester to develop higher-fidelity projects of greater conceptual depth that relates design to an issue in the world that matters for a particular community or audience.

Course structure. Situating interactions took place in four phases, each having their own course literature as well as their own design deliverables. During each of these phases, one full class meeting session (four hours) was set aside as a tutorial session for critique, feedback, and commentary across pairs of groups, although informal feedback was a part of every course meeting. The four phases of the course were *ideation*, *design research*, *prototyping*, and *evaluation/refinement*.

Ideation. In the first phase of the course, students developed a project brief describing their topic, goal, and audience together with a narrative or scenario that guides their design process. In class, this corresponded to lectures introducing design research and research through design [66–68] offering examples of contemporary research in the theme (varying by topic), and discussions of futures, futuring, and design fiction that built from the course literature in *Experimental Design in Practice* (e.g. [28, 42, 43, 54, 69–71]). This component of the course covered imagining futures as well as articulating problems that exist inside those futures. It is meant to help students develop a topic that they find interesting—or interesting enough to motivate a semester-long project—and encouraged approaching a problem from multiple angles.

This phase also built on methods from *Experimental Design in Practice* like constructing narratives and crafting scenarios, but added detail to the theory behind these ideas, attempting to tie these to being foundational to a design process. At the same time, and drawing from speculative design, we encouraged students to engage with design as setting a problem, and not always as creating a product. In this mode, attending to an open and flexible creative process that is appropriately driven by inquiry becomes the essential part. By emphasizing a design agenda instead of focusing on the outcome, we feel this open exploration supports developing creative confidence among students.

Design Research. This ideation phase was followed by a design research phase, leading to a plan that describes what students hope to explore and why it matters for their project, including data-gathering strategies. Students were asked to refine the audience for their scenario and develop interaction design work with this audience in mind. Lectures in this section included community-based design research [72–74], design ethnography and fieldwork [75–77], and various design and design research methods [7, 78–80]. The goal of these readings was to immerse students in design research strategies and with them work to develop a contextual data-gathering and design ideation methods that they could draw on as a part of their project development. This phase of the course was meant to try to take what had been an open-ended process and develop a set of constraints for a student designer to work within in a structured way. Aligning with SCD’s goal of challenging existing status quo, these methods offer ways of engaging with the world by developing an audience for the work and establishing an obligation to that audience, even if only rhetorically. These methods help students to

understand a condition from the inside, and find inspiration to refine their initial design idea to flesh out their imagined scenarios with real-world concerns.

Prototyping. The third phase of the course was a prototyping phase that was informed by students' scenarios, operating in conversation with the audience through the design research findings. In terms of course lectures and materials, this phase covers the basics of prototyping from a more theoretical angle than previous courses, including reviewing a prototype's role and possible purposes [81, 82], and augmenting that with perspectives on how prototypes are used, both generally to know a design space [83] and in design research more specifically [84]. Practically, this was where the course became more hands-on. While there had been ideation prototyping earlier in the semester, students by now had developed a concept that they were hoping to implement. In this phase, students attended a design workshop on fidelity in prototyping meant to help them think through making responsibly and efficiently, to use their prototypes to test ideas as part of an internal process as well as to communicate ideas effectively. Technology workshops on platforms and sensors that had been selected based on project needs offered scaffolding for developing prototypes. During this phase students were also trained to use our institution's prototyping workshop. The theoretical perspectives on prototyping from lectures gave students analytical lenses to apply to their emerging systems, leading to situated ideas about methods that could be put to practice immediately.

Evaluation and Refinement. Finally, the fourth and final phase of the course led to refined prototypes that engaged with the audience in some way. Course literature for this phase of the class included research roles for more refined prototypes [85] as well as strategies for evaluating and interpreting design research objects [86–88]. This last portion of the course was meant to give students an opportunity to develop higher quality iteration of their prototypes, but also to hold them accountable to the audience that they defined earlier. Students are meant to relate the revised prototype to the initial problem definition and context, letting them re-interpret what has been made. At the same time, the goal in refining the prototype was also to develop a story of what this thing that they have made is, presenting their design material as real, substantial, and conveying a concept well. In this process, students build experience with refining a prototype in implementation, and not only as an idea.

The design projects were presented as an exhibition at the end of the semester and handed in to course staff as research pictorials. Pictorials use imagery as well as argumentation to tell a research story about a topic. They combine aspects of report writing, essay-based argumentation, process documentation, letting design materials contribute to the document directly, instead of simply illustrating a point or offering an example. This format allowed students to articulate the findings that they have found in their project as a part of doing design, instead of theorising design.

Project outcomes. This section presents a set of projects to illustrate how the above process has worked to generate design outcomes. Like the selected examples from the course *Experimental Design in Practice* above, this sample is meant to represent a range of design projects from *Situating Interactions*.



Fig. 5. *Designs for Co-living.*

Designs for Co-living investigates shared housing in the near future, considering the increasing popularity of cohabitation, emerging technology trends, and the need to build sustainable futures. Using research through design to explore possible futures of housing, students held a workshop with current co-housing residents helped to understand the physical and experiential structure of their homes as a basis for designing future residences, gaining concrete insights to the experiences of living together. This research resulted in a catalogue of speculative co-housing technologies (after [56, 89]) as well as a science fiction prototype combining the practical and theoretical insights in a 360° VR experience representing future cohabitation as a humorous dollhouse furnished with 3D-printed items from the catalogue.



Fig. 6. *Fruit bowl with a Pulse.*

Fruit Bowl with a Pulse lets people encounter their food in a new way. This project was based on preliminary workshops with sightless individuals to understand their food habits, particularly around rot and decay. This led to an experimental and material design process for people more generally. Students were inspired by how the blind considered fresh food as having a kind of “liveness” or “vitality.” This drove a series of material explorations to determine how to capture and represent this vitality in a domestic object. The fruit bowl with a pulse uses the moisture in fruit to drive a pneumatic heartbeat built into the rim of the bowl. Fresher fruit creates a stronger heartbeat in the bowl. The prototype changes something familiar and banal into

something unknown, defamiliarizing the bowl [90] and inviting for co-speculation into how we might reimagine everyday objects [91] and their purposes.



Fig. 7. *Miyagi*.

Miyagi is a research product [73] that represents an example of a smart plant product that aims to create a stronger presence for and reflections about food plants in our homes. To load a new herb, a user touches the sensor, giving it a name and horoscope sign. Every day, *Miyagi* will print a horoscope for the plant that encourages its owner to reflect on how it is doing. This printout includes an image inspired by microscope slides of chloroplasts that is based on current data about the plant—water levels, sunlight, and so on. The plant’s caretaker places these in a journal, helping them to build an ongoing relationship with the plant and reflect on previous ones. To gather inspiration and develop an audience, *Miyagi* used cultural probes [92] to help the student group learn about existing human/plant relationships.



Fig. 8. The *Bodega Conservation Society*'s suitcase.

Bodega Conservation Society. Until relatively recently, homes in Copenhagen had an average of only two square meters per resident, making the “Brown Bodega,” a distinctively Danish type of pub, the *de facto* living room. Shifting patterns of urban living as well as gentrification has left neighbourhood bodegas standing as relics from a bygone era to be redeveloped or torn down. This prospect led these design students

to imagine conserving the brown bodega. They used cultural probes [92] and design ethnography [75] to explore the materials, values and practices that are found in the bodega—and how these characteristics might enable us to have a discussion on what Denmark might lose if the bodega becomes completely extinct. A traveller's trunk contains materials drawn from the brown bodega and its rituals: a tablecloth for serving *smørrebrød*, beer, expandable social ashtrays, and photo frames that tells stories from brown bodega regulars when their photos are removed from the wallpapered wall of the trunk.

Evaluations and reflections. While not explicitly positioned as a course about speculative and critical design, Situating Interactions positions the role and possibilities for design in ways that align with the goals of SCD. In designing futures to develop prototypes for, students are making claims about what kinds of worlds design can make. In developing a scenario for that future, students are arguing that in these worlds, particular aspects or objects are most relevant and important. Because students define their design problem in an open-ended and ongoing way, there is quite a lot of flexibility in the course that lets them approach it in different ways. For example, students read about the anthropological basis of design ethnography, are introduced to design ethnography methods, and then put some of these ideas to work to develop knowledge of their own design space.

For students with a more theoretical orientation, letting them deploy these ideas immediately gives them an opportunity to not get stuck on thinking about the ramifications of a design idea and instead move towards more concrete insights that can drive prototyping, whether the prototype is exploring technical implementation or form. Conversely, frequent prototyping as smaller parts of a larger design project lets more technical students become familiar with the capacities of technical systems to represent and engage with theoretical ideas and emerging contexts for design through making.

Guiding this open-ended approach was a critique component built into the course, where tutorial sessions over the course of the semester assemble pairs of student groups together with the course staff. As above, each of these sessions roughly correspond to a phase of the course. Kolko [93] describes critique as a necessary component of design, as critique forces an idea to become more robust, and towards something that is realised. Through that process of realization led by critique comes a richer conversation about designing—what he calls confidence in a design process. This feedback was used for students to refine concepts, walk through a planned workshop for external participants, or ask course staff and students to participate in design games [94] or other forms of concept generation.

As a means of bringing in more supervision into the format of design courses, there is a tension between acting as an expert and giving space for students to find their way in the material. Partially, this tension is addressed by shifting roles in the tutorial depending on the phase of the design project: in generative modes, the goal is often to give students more space to ideate and think laterally to develop design concepts. When it is time to narrow down to a particular implementation, then talking over the concepts to identify what could be successful reveals an opportunity where instructor expertise can be shared in a natural, conversational way. This student evaluation comment illustrates how the tutorial sessions were considered helpful: *[The tutorials] worked*

really well with having two groups participate at a time! Guidance instead of judgments, were really nice! By that I mean the fact that we would present our things, and be met with opinions, musings and perspectives, rather than "you're doing this wrong!"

Working from an open-ended brief, students are asked to find something that they think is important or interesting, imagine how that issue might change or emerge differently, and develop technologies that offer different perspectives on that topic. These points align well with the goals of SCD above, as well as how Kelley and Kelley have defined how creatively confident designers work—looking for what is possible, engaging with open ended questions, developing new skills, and attempting to change the status quo [9]. We have found that there have been some issues with this approach in practice. One common issue is that students want to do things the “right” way from the beginning. In other words, students hope that they can know in advance what would make a successful design.

While it is certainly appealing to say that if you do a certain set of steps in a particular way a design will be successful, muddling through the design process is where learning takes place: in how a problem gets productively reframed, how research informs an understanding of the problem, and how various prototypes help a designer to consider aspects of a possible solution. Following a concept to a dead end isn't a mistake—rather, it's how designers narrow the conceptual field. This work of figuring out what is important, what the core of the design concept is, how it suits the problem at hand, and how new understandings of a design context feed back into theoretical concerns is the core of this course. These are higher level and more abstract goals, and better reflect the complexities and contingencies that real-world design is concerned with.

As this is a master's specialisation, it feels like letting the students be responsible and accountable to themselves is appropriate and necessary, especially as they prepare for more self-directed thesis work in the following semester. This comment from the course evaluation illustrates how this has been received: *“I liked that this course [was] more 'free'. I felt like I was being taken seriously, which I don't think I would [have] had as much if I had been given too many 'obligated' exercises. There [was] trust that we as students are mature enough in our knowledge to control our process ourselves.”* For students facing their own open-ended projects in both academic and, shortly, professional contexts, leading their own process here meant that they were able to build confidence in doing design work in that mode.

The comments and feedback above represent a different kind of creative self-belief than those found in Experimental Design in Practice. Possibly due to being a more critique-based and studio-oriented specialisation, and having a less-structured process, students were not only able to gain confidence in designing as demonstrated through their behaviour and resulting projects, but also developed a greater sense of identity as overseeing a creative practice, of having a point of view and of being able to make that point of view clear through design work. To us, this is an example of how an SCD-oriented approach can help students to develop *creative self-awareness*, consisting of the metacognitive recognition of why, when, and how creativity can be applied, as well as developing a creative mindset that reflects a richer understanding of design practice more generally as well as how creative practice can be developed in a practitioner.

4. Discussion

The goal of generalist design programs is to produce design students that are self-assured enough and familiar enough with design to take on design and design-adjacent jobs in information and computing contexts. The kinds of jobs—often UX, often more managerial than production-based—require a different perspective on design than simply learning to execute design processes on their own. SCD lets students experiment with taking problems from multiple different perspectives, and making the problem theirs, to a point that more solution-oriented design cannot match. At the same time, the orientation and speculative agenda of SCD means that many constraints from traditional design do not get in the way of engaging with the problem, as there is no need to account for manufacturability, scale, or other real-world concerns. Instead, design becomes a way of conceptualising a problem and engaging with it earnestly, experimenting with the problem until it becomes something exciting and motivating. Finally, SCD operates with different boundaries than more traditional design. Problems are not bounded by users, products, and services, but issues, contexts, and representation. This flexibility lets different experiences and expertise that students may already have enter the frame, as SCD operates at the fringes of markets, product solutions, and technologies.

Our main goal of this paper is to unpack how SCD can help generalist design students to develop creative confidence, drawing on course evaluations, design materials, reflections on courses, and our own intention in course design. Before we discuss in more detail how SCD in design education can foster creative confidence, we elaborate on the promises and possible pitfalls of SCD in design education.

4.1 The Promise of SCD for Teaching Creative Confidence

Perhaps the most fundamental reason to use SCD perspectives in design education is that they change a student's relationship to designing, making them think differently about what design does and can do. SCD offers a new **orientation** for students to imagine the capacities of design. It offers perspectives beyond user-centred design to develop new products and services to position design and designing as a form of inquiry that produces new social worlds. It enables them to gain experience in thinking through a problem deeply, imagining worlds that this problem could be magnified or be made important to, developing flexibility in telling a story around their design concept, and giving form to these ideas as part of a structured, reflective process of design. For example, *Miyagi* takes a common part of an herb garden, and through a design process asks what kinds of social relationships might be possible if we took the plant more seriously? Similarly, and perhaps in reverse, *Fruit Bowl with a Pulse* started with an inquiry about how sightless people know whether their food is fresh and found an intriguing perspective on the liveliness of food that became represented for a different audience.

A second promise is the **flexibility** that SCD offers. SCD's open remit to develop projects gives students with more technical abilities the ability to use these technical skills to develop things that they believe matter, and to develop reasons and rationales for applying technology to a problem. At the same time, a speculative approach offers

less technical students a setting without real-world obligation to experiment with technology in open-ended ways. Here, removed from the need to be obligated to functionality, students can produce design work that explores different modes of craft and modes of living, as was the case with *Designs for Co-Living*, novel forms of interactions drawing from unusual users, such as the *Fruit Bowl with a Pulse*, or implications of current technological developments taken to the extreme, as was the case with the *Centre of Data Donation*.

A third promise that we observed in the course reflections and evaluations was that SCD asks for a more **creative** act of design than non-SCD practice. SCD was seen as ‘thinking outside the box.’ As a design practice, it is less constrained and allows students to work more freely, yet within a setup that establishes a link to the present—often in playful ways. For example, *Smart Crops* uses existing TV-show genres to present a fictional service and illustrate a possible future. The *Brown Bodega Conservation Society* uses contemporary forms and materials to playfully reshape and reimagine a fading cultural monument, while critiquing contemporary urban trends.

Fourth and finally, engaging with SCD requires a more **authorial** investment in the work that positively influences ownership of a scenario, idea, or service. We have seen that SCD asks students to look inwards, into their beliefs and related value structures. This supports the idea that design is an authorial act that projects what is regarded as desirable. Such awareness of the act of design and the role of the designer therein, in combination with it being regarded as a creative endeavour, positively contributes to fostering creative confidence.

These four factors are why we believe that SCD is useful for a generalist design education, especially in a shorter time frame: It approaches design in ways that students are motivated by and comfortable with; it understands design as a fluid agenda that can move in many different directions—as a liberal art, as managing a process, as finding user problems, as prototyping and making materials, and as arguing for alternatives in the world.

4.2 Pitfalls of SCD in the Classroom

At the same time, we see some concerns when using SCD in the classroom—possible pitfalls that can get in the way of design education. The first issue is that students don’t always **see value** in speculation when designing. The concern from this perspective is that the problems are not “real world” enough, that the methods used are not closely related to developing actual products or services, or that the concepts are too remote to give them marketable skills after graduation. Relatedly, there is sometimes an artificial separation imagined by students that separates the methods of SCD from “normal” design processes. Here, students conflate the epistemology, methods, and outcomes of normative design and SCD. While the question and outcomes might be somewhat different across these modes, the methods are similar, and executing a design process—even if it feels uncomfortable or confusing—has a concrete benefit to students. For some, this indeterminacy in the process has meant that they have felt that the process itself has been unsuccessful (or at least unsatisfying) and that more refined or structured methods would lead to a better design process or stronger outcomes: that for example taking a fully user-centred approach would give them a more concrete linkage from

step to step in design. In this case, emphasizing that the design process itself is quite similar may help a student find value at least in the doing of design, if not the overall orientation of SCD.

Another issue is that because student profiles differ, their motivation and interest to explore via design varies. Some students use the **open-endedness** of a SCD approach as a shortcut, rather than an opportunity to engage a problem space in a robust or considered way. When this happens, speculative design is used as a justification for work that is not richly considered, or that speculative design that means “anything goes,” giving students a license to be lazy or rationalize their efforts as mere speculation. This may be that the difference between SCD and “normative” design is hard to understand for students new to the distinction. The sometimes-ironic character of SCD leads to concepts that are jokey, or that operate at only the surface level without offering much reflection or depth.

As brought forward in one of the course comments, developing the design material to appropriately bring across an SCD proposal requires **skills** in doing design work with various materials, most notably video editing and material prototyping in the presented courses. While video editing software and rapid prototyping possibilities are becoming simpler and are increasingly available, they still require a serious engagement to make something well. This can create an imbalance in the time that has to be spent learning specific tools, opposed to time that could be spent developing the SCD proposal. Naturally, these are intertwined, though we have observed it as a hurdle to be overcome.

Finally, for larger courses, where course scheduling and exercises must be tighter than for smaller, studio based, and conversational courses, a potential pitfall of SCD can become that creative confidence is *retrospectively* found in the **methods** to structure the course, for example, the combination of exercises, instead of the richer studio-driven and critique-based approach. As stated in the introduction of this discussion, SCD can be quite like design thinking mechanically. Upon completion of a larger, more structured, SCD course, a pitfall can be that, as is the case with design thinking, the structure is where students find confidence. From this stance, we would naturally argue for smaller classes that have an ongoing conversational component in them. Nevertheless, we feel that the promises outweigh the pitfalls, and that course design, teaching, and feedback can help address most of the above issues in practice.

4.3 Fostering confidence in design with SCD

The three modes of design—first what Dunne and Raby have characterised as “normative design,” or design that seeks to produce products and services oriented towards market needs [40]; second the design thinking process; and third speculative and critical design—all look alike in practice. The methods of sketching, formgiving, idea-selecting, and so on are all very similar. Indeed, returning to Tonkinwise’s *Just Design*, any kind of design that doesn’t attend to building better worlds or does speculation is irresponsible [28]. Methodically, SCD looks like design thinking, but there is a qualitative difference. An SCD orientation to design does not involve different methods than design thinking, but instead offers a different orientation to design—not as designing a product or service, or as design to produce innovation, but instead to use

design to inquire. Here we want to make it clearer why we think that SCD offers something useful for building this richer kind of design skill for students.

Materially, design is about synthesizing engagement with a condition to a particular instantiation that addresses concerns about that condition—an *ultimate particular*, after Nelson and Stolterman [95] that does what Simon has called *satisficing*, or improving that condition to a preferred state [96]. Design of any variety is fundamentally about this process of articulating a problem and improving it, and is best taught through a critique based, studio setting that offers guided entry into a practice and a reflective mode of understanding the problem, integrating a designers' own values and beliefs, and through iteration moving towards a solution that best addresses these concerns [97]. If we think of the methods and commitments of how we get to this material outcome, however, we think that there is a large difference between different framings of design.

Design thinking offers a methodological framework for that engagement that structures it in a particular way, and perhaps produces designers who rely on that structure. We argue above that design thinking flattens a design engagement, offering a model of how to do design that is certainly true, but also abstracted to become universal—it describes a generic design process that can be taken up by novices as a kind of recipe for producing “innovation.” This conflation of process and results means that getting to an outcome becomes the focus of doing design, and the actual messy, contingent practice and complex, multivariable decision-making that design relies on is lost. Nelson and Stolterman describe the process of becoming a designer as becoming expert in three domains: first as a *routine expert*, then as an *adaptive expert*, and finally as a *design expert* [95]. We see this expertise in *routine* as being like models for design activity including design thinking. These models can support developing creative confidence in the mechanical practices of design reflected by ideas such as creative self-efficacy and creative self-concept. However, this richer mode of *adaptive* expertise, of knowing how a problem relates to broader conditions in the world, and there by demonstrating *design* expertise, is reflected in how a project becomes adapted to conditions, and what kind of approach a designer takes towards a problem.

Similarly, Löwgren and Stolterman describe the qualities of a designer as being comprised of design *ability*, but also design *intelligence* [1]. They characterise design ability as the skills and knowledge of doing design, craftsmanship and creative production, and how this knowledge can be productively deployed. To us, this seems akin to the idea of design thinking, and possibly also simple creative confidence, or knowing that you can produce design work. When augmented with design intelligence, though, there is something a bit richer in terms of intent. Löwgren and Stolterman here describe skilful design as producing work that is intentional and “consciously trying to achieve change in the world” [1]. This is fundamentally in alignment with the intentions of speculative and critical design as way to engage with issues outside of the studio and establishes a different role for design. Design thinking offers one way to do design that emphasizes method, while SCD emphasizes content or criticality. Here there is a strong parallel with the creative confidence idea of creative self-awareness, particularly around creative metacognition [12]. This comes along with the idea of designers setting their own agendas and building systems that seek to produce change in the world: knowing when, why, and how to use design creativity well and having the corresponding mindset that keeps that agenda active.

While perhaps not always successful in setting agendas for social concerns, the design work above engages in complex spaces indirectly and demonstrates sensitivity to the idea of design as more than building a marketable product or satisfying user needs. These courses, *Experimental Design in Practice* and *Situating Interactions*, attempt to build this design orientation in students in different ways related to different structural requirements. We found that the larger course size and the resulting rigid structure of *Experimental Design in Practice* may have been less successful in developing creative self-awareness and the corresponding designerly metacognition, as evidenced by the course evaluations that weren't sure of the utility of this approach. At the same time, as a production-based course, it still gave students an opportunity to develop and refine their own creative behaviour and identity and build creative confidence in terms of creative efficacy and creative self-concept. *Situating Interactions*, as a more studio-oriented course based on critique, resulted in feedback from students about working with fewer constraints and owning their process, defining problems in a setting, and thinking through problems in those contexts—reflections that align well with the idea of creative self-awareness as well as SCD.

In *Art and Design Pedagogy in Higher Education*, Orr and Shreeve describe *stickiness* as a metaphor that reflects the complexities and contradictions of teaching design, and use it to consider the design curriculum: *Rather than a curriculum which is understood as content consisting of lists of topics and engagement in pedagogies which help students to learn those topics, we see the curriculum as a complex web of activities in which students forge a way to becoming a creative practitioner. The sticky curriculum presents ambiguity and unclear options which require negotiation for those working in higher education; for those translating creative practice into pedagogic activities; for those who are in a position as learner and find themselves as experts in innovative forms of knowledge and processes and for the technical teams supporting material learning opportunities. All these participants encounter the stickiness of fluctuating roles and responsibilities in studio learning environments, whether these are located in virtual spaces, in the studio, in the university or outside it [97:7].* This idea of *stickiness*, of embracing ambiguity and working in emerging contexts, shifting roles, and contingent means, echoes the orientation and ideals of speculative and critical design in developing a creative practitioner, and perhaps conversely, offers a way into developing sticky thinking that helps students engage with ambiguous and open-ended design projects. In texts cited earlier in this paper, the “design thinking mindset” is used as a shorthand for a multitude of traits that lead to design innovation [10, 19]. Perhaps in place of these traits we can offer a different shorthand: the “speculative and critical mindset” of designers who are confident enough in their creative practice to engage with problems that are important, use design as a means of inquiring into society, and propose alternatives via their work.

4.4 Limitations, reflections, and future work

This article connects academic notions of creative confidence to practices of design education. By moving beyond a popular understanding of “creative confidence” and taking it seriously as a foundational goal of design education, we argue that speculative and critical design can be a powerful tool to meaningfully develop creative confidence

among students. We certainly do not intend to claim that our mode or goals of teaching are somehow novel—it is certainly true that how SCD (and design more generally) is taught in many institutions looks like the methods, processes, and practices presented here. Rather, this article is a synthesis of some current reflections on design instruction and an articulation of our experiences as educators and designers on how our design courses have gone, what we feel has worked, what has worked less well, and why we think that it has worked this way. For us, linking these practices to ideas from creative confidence and design theory has become a lens that we can use to critically reflect on our own practice and aims as we constantly update, adapt, and hopefully improve our teaching.

We should note that the coursework and projects described above take place in a Northern European context, and perhaps do not go far enough in reimagining what future technological worlds could be like, or how issues of class and justice could be engaged with in meaningful ways. As mentioned above, contemporary SCD has rightfully been criticized for being centred or oriented towards Western fears of collapse, and of imagining dystopic futures that are too-often already occurring in the global south and among marginalized peoples [45]. These concerns have led to criticism that SCD is another way that wealthy Western voices are being made primary, leading to calls that design itself should be decolonized [98]. More and better work in this direction is even more urgent when we think of how SCD imagines itself as generating futures that indicate better ways to live, and there is a responsibility to imagine just, varied, and inclusive futures.

Finally, because this paper is based on reflections on how we understand our courses to have gone, and what we feel are sensible, productive ways to build creative confidence in students, it is limited to our own courses and the data that we have had on hand to interpret them. What is currently missing is how students self-report how their creative confidence has developed both during these courses as well as over the broader education programme. Future work in this direction would be to include more formal assessments of creative confidence in the evaluations of the courses: pre-course questions can come as part of the expectation-management surveys at the start of a semester, and self-assessment of creative self-beliefs as part of course evaluations. Further, these questions could be asked of students beginning the programme as well as in exit surveys to students upon graduation. More concrete data about how students would establish that these and future courses provide a robust design education that generates self-assured design professionals.

5. Conclusion

Why does Speculative and Critical Design practice contribute to developing creative confidence in interaction design education? For us, SCD's emphasis on creating new worlds and scenarios for design offers students the responsibility as well as the privilege of taking a design problem from all sides, setting as well as solving problems that imagine the world in new ways—not just as it has been, but as it could be. In doing SCD, students engage with problems that reframe not just a particular problem, but also reflexively the capacities and role of design itself. We align this perspective on design

with how creativity studies have approached the idea of creative confidence as stemming from a set of beliefs in one's creative self-concept as effective and, as having a creative mindset, and as having creative metacognition, coupling creative confidence with creative self-awareness. At the same time, we can see that the promises of SCD in design education can also lead to possible pitfalls: SCD's orientation to design can be perceived as not adding value to the 'real world', its flexibility in how design operates can become a shortcut for student designers, and the promise of the authorial investment correspondingly requires a certain level of skill in form-giving in order to make a discursive story legible and effective.

This paper offers an argument for a generalist design programme that develops creative confidence and creative self-awareness via SCD, describing why we teach certain classes in a particular way, and offering possible directions for design education—promising avenues for future teaching and possible pitfalls that may need to be managed. While we cannot support these ideas empirically, we feel that there is potential in using SCD methods to drive student design confidence. Beyond building creative confidence, we believe that an SCD-focused design education also makes clearer the ethical stance of designing. Design always comes from a designer's belief systems and values, and SCD positions those explicitly as part of what it means to do design. Producing designers that intrinsically understand that design is situated, contextual, and a product of cultural beliefs and values leads to better designers, and in the context of our generalist design programme, we believe that sensitivity to these issues produces better project managers, design coordinators, planners, and strategists as well. Creative confidence as produced through SCD is a route to producing graduates who know design as a form of inquiry to engage with the world richly, humanely, and meaningfully.

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