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“How am I supposed to tell my mother what happened in today's class?”: at the intersection between blended learning and design (thinking) education

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Abstract

Since the beginning of the 21st century, design education has been gaining momentum across disciplines as a means to equip students with skills relevant in the job market as well as to tackle wicked problems. One of the core assumptions behind integrating design education to other disciplines focuses on the need for hands-on and experiential opportunity exploration and collaborative learning, often prevalent in studio-based settings. However, as the Covid-19 pandemic has shown, physically accessing the campus or the studio is not always feasible, so how might this impact multidisciplinary design education? Acknowledging the notion that we no longer can take face-to-face learning for granted, this paper ask what aspects of design (thinking) education could be delivered in blended environments. I contribute to this body of knowledge by investigating students’ perceptions of their learning about design methods and processes in a problem-based blended learning course focusing on design and multidisciplinary teamwork. Visual learning diaries of forty-seven students were analyzed to better understand how blended learning can support or hinder learning about applying design to societal issues. Data analysis revealed three aspects – triggers for personal development, exploring ambiguity, and technology as providing structure – that form the concept learning frame. This concept sheds light on how the students perceived blended learning elements influencing their learning about how design could be applied to societal issues. Findings contribute to further dissolving the physical-digital dichotomy in design studio and education. Pedagogical implications focus on how blended learning can promote student agency in design education across disciplines.

Keywords:

blended learning, design education, design thinking, problem-based learning, student agency

Introduction

Since the beginning of the 21st century, design education has been gaining momentum across disciplines as a means to equip students with skills relevant in the job market as well as to tackle wicked problems (e.g. Çeviker-Çınar et al., 2017; Garbuio et al., 2018). Furthermore, the concept of design thinking has popularised designerly ways of thinking and crafting (Dunne & Martin, 2006; Garbuio et al., 2018; Rowe, 1987), often compressing the material and cognitive complexities into a set of tools and methods (e.g. empathy map and customer journey) utilised in a linear fashion.

Building on the above, one of the core assumptions behind integrating design education to other disciplines focuses on the need for hands-on and experiential opportunity exploration and collaborative learning, often prevalent in studio-based settings (e.g. Barry & Meisiek, 2015; Brandt et al., 2013; Garbuio et al., 2018). In their review on design thinking courses across 28

universities, Wrigley and Straker (2017, p. 383) highlight how teaching design thinking "should take a problem-based and studio-based approach". However, as the Covid-19 pandemic has shown, physically accessing the campus or the studio is not always feasible, so how might this impact multidisciplinary design education?

Indeed, it can be argued that design thinking's signature pedagogies (Shulman, 2005) have been understood to rely, to a large extent, on face-to-face learning in studio-based environments, and similarly Jones and Lotz (2021, p. 4) argue in their editorial "that moving studio-based curricula online is a non-trivial exercise", yet "being able to make informed and effective change is important, as well as being able to articulate and support such change in education settings that might not fully understand the modes of learning and teaching required for design education" (Jones & Lotz, 2021, p. 6). In other words, acknowledging the notion that we no longer can take face-to-face learning for granted, what aspects of design (thinking) education could be delivered in online / blended environments?

Given that prior studies have suggested blended learning to hold potential in creating engaging learning experiences (Arbaugh et al., 2009; Perera et al., 2020; Proserpio & Gioia, 2007; Redpath 2012) by promoting active learning (Shieh, 2012), in this article I ask the following question:

> *How can blended learning support or hinder learning about applying design to societal issues and with what kind of implications for students?*

With this research question, I aim to contribute to discussions on how design thinking education could be delivered in a blended learning format (e.g. O'Toole & Kelestyn, 2021). Fully acknowledging the baggage that comes with "design thinking" (for a review, see O'Toole & Kelestyn, 2021, p. 241-242), in this paper I am utilising the concept to discuss design education outside design's domain. Further, problem-based learning, echoing Dewey's (1938) traditions on experiential learning, is understood as focusing on tackling real world problems and reflecting on the learning process (Albanese & Mitchell, 1993; Hmelo-Silver, 2004), thus emphasising the student's active participation in the course instead of following a boilerplate template. Building on previous literature on designing frameworks for blended learning (Kim et al., 2014; Lee & Hannafin, 2016), in this paper I propose learning frame in the form of real-life problems as a pedagogical concept to anchor the learning outcomes concerning design as a social catalyst.

In line with prior studies, blended learning is defined as an intentionally designed combination of online and face-to-face pedagogical activities with between 30 and 70% of the course's components and activities delivered online (as per Allen & Seaman, 2010; Bernard et al., 2014). The course studied here entails 135 hours of studying, out of which thirty hours were classroom hours and the remaining hundred and five hours was devoted to classroom preparations and independent teamwork. All in all, thirty-five to forty hours were devoted to online activities and interaction.

Literature review: on blended learning and teaching design

Design education across disciplines

Perhaps due to design's strong anchors in the real world, teaching design outside its own domain has been gaining currency not only in business schools (Dong et al., 2016; Lynch et al. 2021; Schumacher & Mayer, 2018), but also in engineering (Coleman et al., 2020; Dym et al., 2005) and medical sciences (van der Westhuizen et al., 2020), for instance.

As Garbuio et al. (2018, p. 55) and Gaiardo (2019, p. 213) point out, teaching design for students outside the design discipline should focus on the cognitive aspect; that is, learning to understand the complexities and competencies related to design instead of solely focusing on the tools and methods (e.g. customer journey maps, empathy mapping, and user personas) often regarded as archetypal for design. In a similar vein, Sarooghi et al. (2019) highlight design's role as providing crucial clarity for opportunity creation that is one of the cornerstones of entrepreneurial thinking and value creation. However, while most studies investigating design education in business schools seem to focus on entrepreneurship education, design's importance goes beyond new venture creation, as more established organisations are also regarding design as a strategic resource (Fixson & Rao, 2014; Fixson & Read, 2012; Knight et al., 2020).

Thus, we now know teaching design involves not only tools and methods, but also the cognitive aspect (Garbuio et al., 2018; Goel & Pirolli, 1992) as well as a more refined understanding of the theoretical underpinnings (Dell'Era et al., 2020). As Lynch et al. (2021, p. 9) note, students can go beyond superficial learning in problem-based settings. Investigating how students develop their design competencies beyond tools and methods has received relatively little attention, which is why we ought to explore pedagogical structures that support or hinder this development (in line with Nae, 2017).

Blended learning supporting the emerge of active learning

Blended learning has broadened our understanding on how we can reach our students in ways that increase their engagement and enables them to claim ownership of their learning (Arbaugh et al., 2009; Daspit & D'Souza, 2012; Owston & York, 2018). Recent reviews on blended learning in the business disciplines have highlighted the activating benefits of blended learning environments (e.g. Arbaugh et al., 2009; Arbaugh et al., 2010). Similarly, Fathallah et al.'s (2022) study on remote learning in architecture found that online learning has certain benefits (e.g. reduction in commuting) yet at the same time it is imperative that the course infrastructure supports learning.

More specifically, one potential model to encourage students' active role in the learning process is anchored instruction that "is designed to help students develop useful knowledge rather than inert knowledge" (Bransford et al., 1990, p. 123). Similarly, Eriksen and Cooper (2017, p. 389) discuss Community of Becoming as a concept "to emphasise the continuously emergent and relational nature of students as humans". Thus, while blended learning has the potential to grant more agency to the students in the form of organising activities as they see fit, at the same time there is a need to create structures that enable them to do so (see also Lehtonen et al., 2022).

Notions concerning students' agency are connected to broader discussions on teaching in higher education institutions that have advocated a departure from top-down teaching towards more collaborative inquiry (Bacon & Stewart, 2016; Davidson, 2017; Eriksen & Cooper, 2017; O'Flaherty & Phillips, 2015). Yet, in this context of transforming teaching and learning in higher education, debates have often mistakenly focused predominantly on the technological aspects (Cavanaugh et al., 2016; Kitchen & McDougall, 1999). On the contrary, and in line with extant research on new pedagogies (Redpath, 2012; Sezer & Abay, 2019), we should not only be looking at how technology improves or hinders learning, but instead what kind of pedagogical approaches and structures enable us to support active and collaborative learning in blended learning contexts (Arbaugh et al., 2010; Daspit & D'Souza, 2012; Kim et al., 2014).

Studies looking into blended learning have tremendously increased our understanding of what kind of content can be taught online and how (e.g. Cavanaugh et al., 2016; Kim et al., 2014; Owston & York, 2018; So & Brush, 2008). Despite some of the criticism geared towards blended learning (see Redpath, 2012 for a review), this pedagogical transformation is not about technology, but it first and foremost concerns improving the students' learning experiences (Daspit & D'Souza, 2012; Kim et al., 2014). As such, creating structures for learning experiences that are situated in real life (Christopher et al., 2017), or what Bransford et al. (1990) refer to as anchored instruction and Jonassen (2000) as a better understanding of problem-solving processes, is potentially a fruitful way to introduce design education across disciplines.

Synthesising literature on design education and blended learning

Acknowledging the importance of studio-based learning, more attention is required to exploring how sustainable this form of teaching design really is. As the Covid-19 pandemic has shown, relying on face-to-face learning is not always an option, thus raising concerns about the future of design education if we do not have access to the physical premises (e.g. Jones & Lotz, 2021; Lehtonen et al., 2021). To move forward, this paper explores blended learning as a potential way forward to diversify the approaches we mobilize to teach design outside its disciplinary domain. Given that blended learning places primacy on student engagement and agency (Daspit & D'Souza, 2012; Kim et al., 2014), it is worthwhile to combine design education and blended learning to explore what kind of pedagogical structures support and hinder students' learning about design as a catalyst for societal change.

Research context: Designing IDBM Challenge

This paper focuses on students who took IDBM Challenge, Aalto University's multidisciplinary graduate program International Design Business Management's (IDBM) introductory course on multidisciplinary and design-driven teamwork that was taught in 2017 by drawing on blended learning and problem-based (Helle et al., 2006) methodologies. Forty-seven students took the course (between twenty-one and thirty-nine years of age): forty-one students from the IDBM program (both major and minor students) and six students from Station (https://www.station.dk/), a student-driven organisation bringing together students from universities in Denmark. For the latter, this course was optional and the first two weeks they joined remotely with two of our local colleagues serving as additional facilitators during the workshop sessions.

IDBM Challenge was a three-week long intensive graduate-level course that weaved together studio or workshop-based learning (Barry & Meisiek, 2015) and blended learning content

(podcasts, videos, collaboration software) within a broader framework of collaborative and problem-based learning. To further illustrate the components created and utilised to support the students' learning outcomes, Figure 1 visualises the course in a temporal fashion.

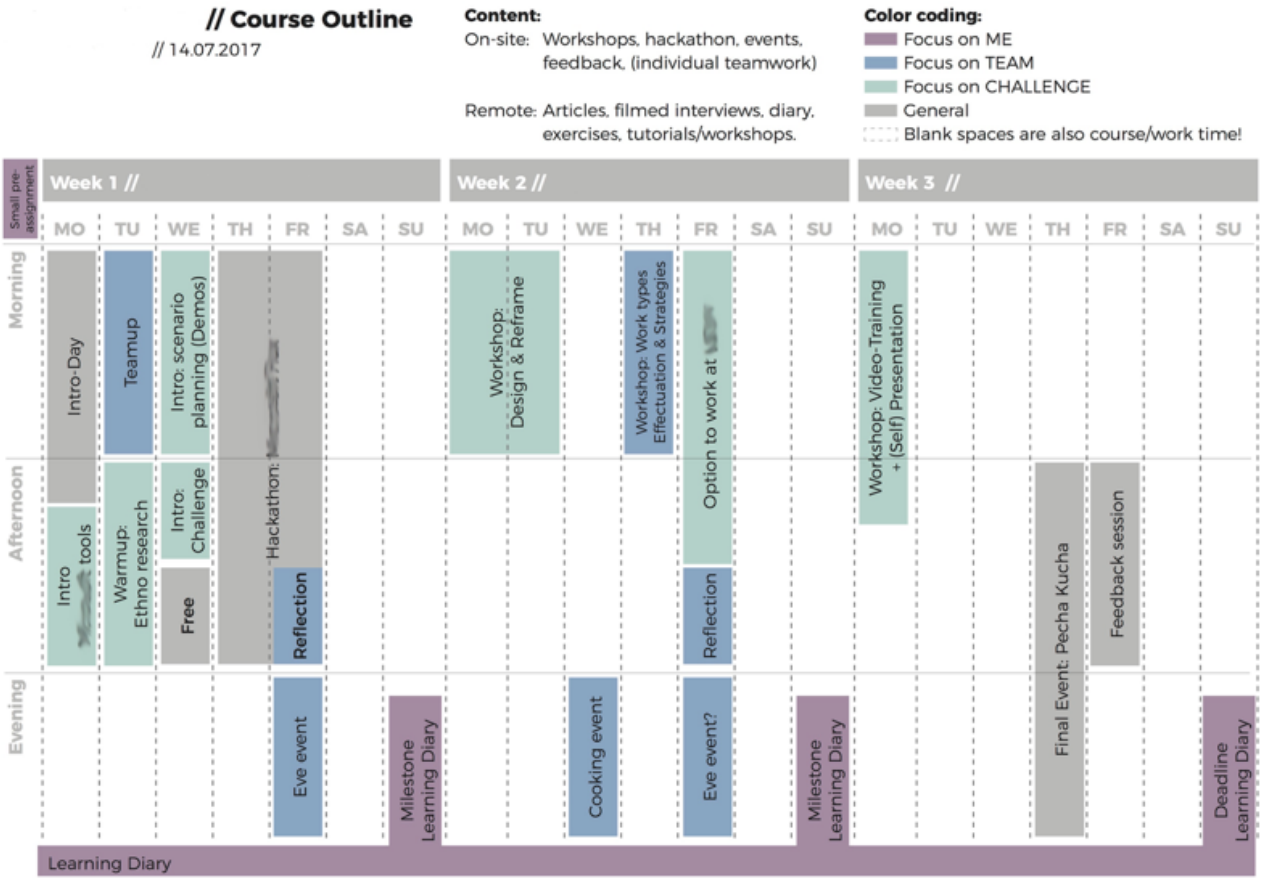

Figure 1. Visualised outline of the course components

During the contact hours, the students practiced methods and approaches related to teamwork and design-driven projects: for instance, Cooking Slam activity for translating effectuation theory (Sarasvathy, 2001) into practice, visual failure curriculum vitae (Seelig, 2016) to share learnings from failures with the team, and the team analysis tools focused on team roles (as per Belbin, 2010). More specifically, the course consisted of 135 hours of work, out of which thirty-five hours were contact hours and the remaining hundred hours were intended for individual teamwork and blended learning. Furthermore, blended learning content (e.g. podcasts and videos specifically created for the course) was organised so as to support the teams' projects while contact hours were structured so that instructions for each day were provided in the beginning and during the day the teams were progressing at their own pace. Thus, the purpose behind the course design was to provide structures "so students are the center of the story and are able to gain unique and individualized learning insights from each learning activity" (Lund Dean et al., 2022, p. 8).

To facilitate learning about teamwork and design, the students were divided into twelve teams that were formed by the teaching team based on gender, discipline, and nationality. In line with the intended learning outcomes, the teams had two tasks: the team-level task focused on

creating a future scenario focusing on outer space, while the community-level assignment was related to the final event the whole cohort was expected to organise (see Kim et al., 2014; Lee & Hannafin, 2016). More specifically, the final event was organised as a multisensory PechaKucha – a presentation format consisting of twenty slides, each shown for twenty seconds – event that was open for everyone to attend.

Each team was randomly given one of the four design briefs dealing with outer space that we co-designed with a Finnish start-up specialised in astronaut training (see Table 1). More specifically, the instructors were responsible for the pedagogical aspects in the briefs, while the start-up provided us with insights on what kind of developments were considered as more or less likely in each year (e.g. by 2037, it is possible – not certain – that space tourism will become available for broader audiences).

Table 1. Design briefs for the teams

Year	Scenario briefing – what kind of societal, political, and economic implications each scenario might have on societies back on Earth?
2027	The International Space Station (ISS) is expected to be decommissioned by 2028 – as such, commercial stations might be set up as alternatives providing hotels and manufacturing capabilities.
2037	Space tourism will become available for broader audiences – to what extent will this impact life on Earth? Will it dissolve or reinforce class divisions?
2047	Asteroid mining financially feasible – how will this influence firms and their competitive advantages and, ultimately, distribution of wealth across societies?
2057	Mars will be colonized – whilst this is the most distant scenario, what kind of ethical and moral issues might this development in the history of humankind bring about?

The problem framing invited the students to focus on two aspects in their final concepts: first, how does life on Earth look like in the future (i.e. creating future scenarios), and what kind of design-driven solutions could they devise to solve societal problems or challenges within this context. Thus, one of the main objectives of framing the design briefs this way was to draw the students' attention to two things: first, technological developments do not necessarily advance welfare in societies in a linear fashion, and second, if certain development trajectories might lead future societies into mayhem, how could design serve as a catalyst to draw our attention to potential perils.

Methodology: visual learning diaries

In line with qualitatively informed studies looking at blended learning (Daspit & D'Souza, 2012; Pachego et al., 2018) and design education (Gaiardo, 2019; Garbuio et al., 2018; Lynch et al., 2021), students' visual learning diaries were utilised as the data set to understand how the students reflected on their learning experiences and outcomes throughout the course. Especially during the last few years, visual research has been gaining momentum (Boxenbaum

et al., 2018) and visual data is well suited for exploring meanings that are not easy to express in a textual format (Höllerer et al., 2018).

The visual learning diaries were submitted digitally through the online collaboration software utilised during the course, and the students were instructed to cover reflections on the following aspects for each day of the course: course readings, workshops, video episodes and podcasts, teamwork, and digital tools. Students' permission was obtained to use the anonymised learning diaries for research purposes. In addition, the students were invited to reflect on the style and format they chose for their visual learning diary since they are both important when it comes to sensemaking.

Data was analysed by mobilising the Gioia methodology (Gioia & Chittipeddi, 1991; Gioia & Pitre, 1990; Gioia et al., 2013) that is well suited for exploring emerging phenomena with the aim of generating theoretical insights (Figure 2). Furthermore, due to the methodology's emphasis on a systematic approach (Magnani & Gioia, 2022), it can transparently communicate how theoretical insights were derived from data.

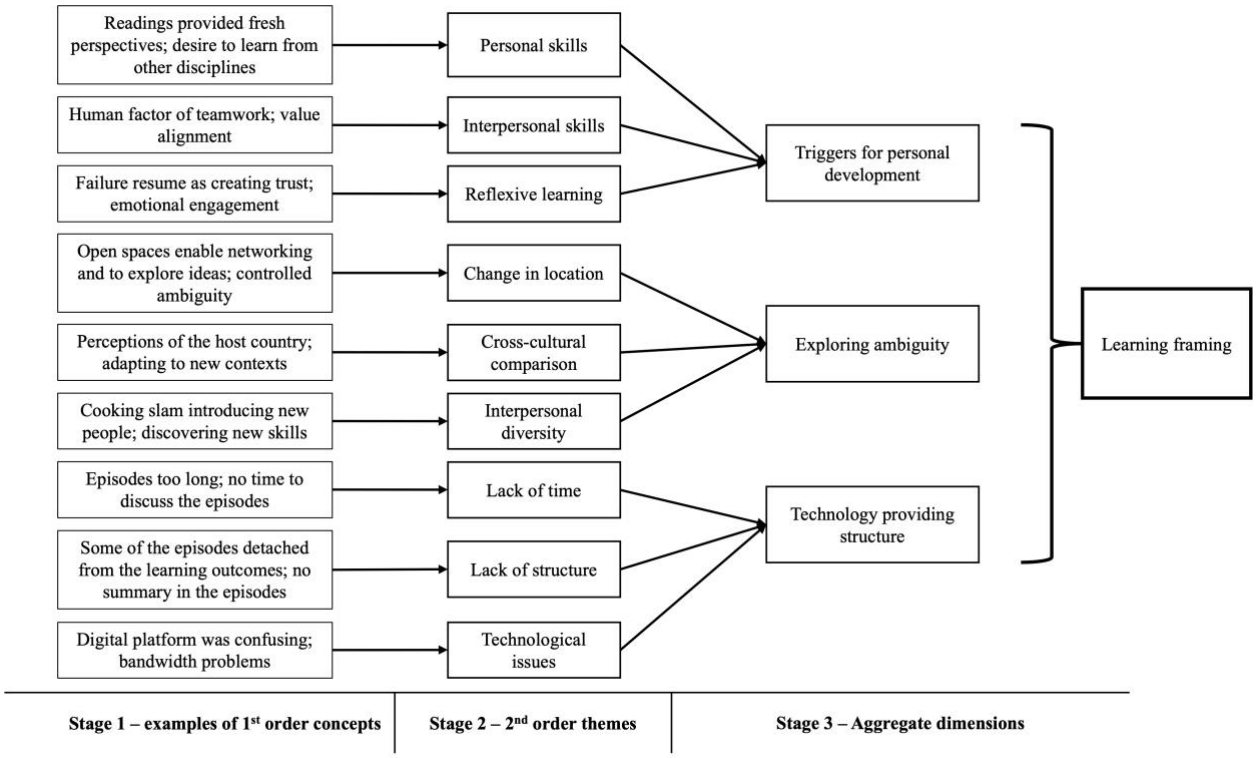

Figure 2. Data analysis process visualised according to the three phases

The first-order concepts on the left side are words, images, and symbols used by the participants – visual learning diaries were first read and reread to look for relevant codes. At this stage, codes are generated to look for emerging patterns, after which codes are grouped together so the data is easier to analyse. Once I felt no new concepts were emerging from the data, I started categorising the concepts into second-level themes. The purpose here is to raise the abstraction level from the first-order concepts by exploring connections and interdependencies between the concepts: moreover, categories emerging from this phase are traditionally researcher generated. Further, 2nd order themes emphasise "nascent concepts that don't seem to have adequate theoretical referents in the existing literature" (Gioia et al.,

2013, p. 20). Finally, the two phases were combined by forming aggregate dimensions that provide a conceptual framework for theorising on students' experiences during this blended learning course. This last stage is what Gioia et al. (ibid., p. 22) refer to as building a theoretical model that "is grounded in the data (as exemplified by the data structure), one that captures the informants' experience in theoretical terms". More specifically, the concept of learning frame is thus a theoretical explanation of how the students perceived blended learning elements influencing their learning about how design could be applied to societal issues.

Findings: three aspects of learning frame

Data analysis described above resulted in three aggregate dimensions that shed light on how blended and problem-based methodologies can support learning about design in a way that integrates the university context with the surrounding society. Taken together, I conceptualise their interdependence as learning frame; a framework for designing blended learning environments that can facilitate learning about applying design to societal issues. More specifically, the learning frame concept should be understood as a building block for design (thinking) education that goes beyond the traditional physical studio (e.g. Jones & Lotz, 2021). The three dimensions comprising the learning frame will be discussed separately in the section below, after which they will be synthesised in discussing learning frame in more detail.

First aspect: Triggers for personal development

Since focus here is on a three-week intensive course, we can hardly talk about transformation in our students that would have taken place immediately after or during the course. However, we can nonetheless discuss triggers for personal growth and self-reflection: that is, pedagogical methods that have the potential to transform participants. Figures 3 to 5 show why the participants found some of the teaching methods meaningful.

There's no limit to the amount of cheesy quotes you can find about cooking bringing people together - but hey, after our Cooking Slam I have to say, maybe there's some truth to it. What was really fun about our task was that everybody had something unique to bring to the table. I found myself constantly surprised by people's hidden talents. An engineer who also happens to be an expert in preparing beet mousse? Cool!

Figure 3. Participant describing how cooking together related to learning

Being thrown into a random team of people with(out) culinary skills, having to deal with ingredients I/ we don't usually cook with (not to mention the arbitrary combination), and then increasing the complexity of adding the "risk" and "opportunities" with the added factor of a time limit, the whole session was very invigorating.Stressful? Yes. and very master chef-esque, but it was refreshing. I think it felt a bit like a creative sprint?

I really like how you managed to incorporate the effectuation theory into that session, that was brilliant! :)

Figure 4. Participant sharing thoughts on the Cooking Slam

From the very beginning, it was great to be on a team where our values aligned in terms of what we wanted out of this course. We all wanted to learn and have fun doing so and grades weren't our primary concern.

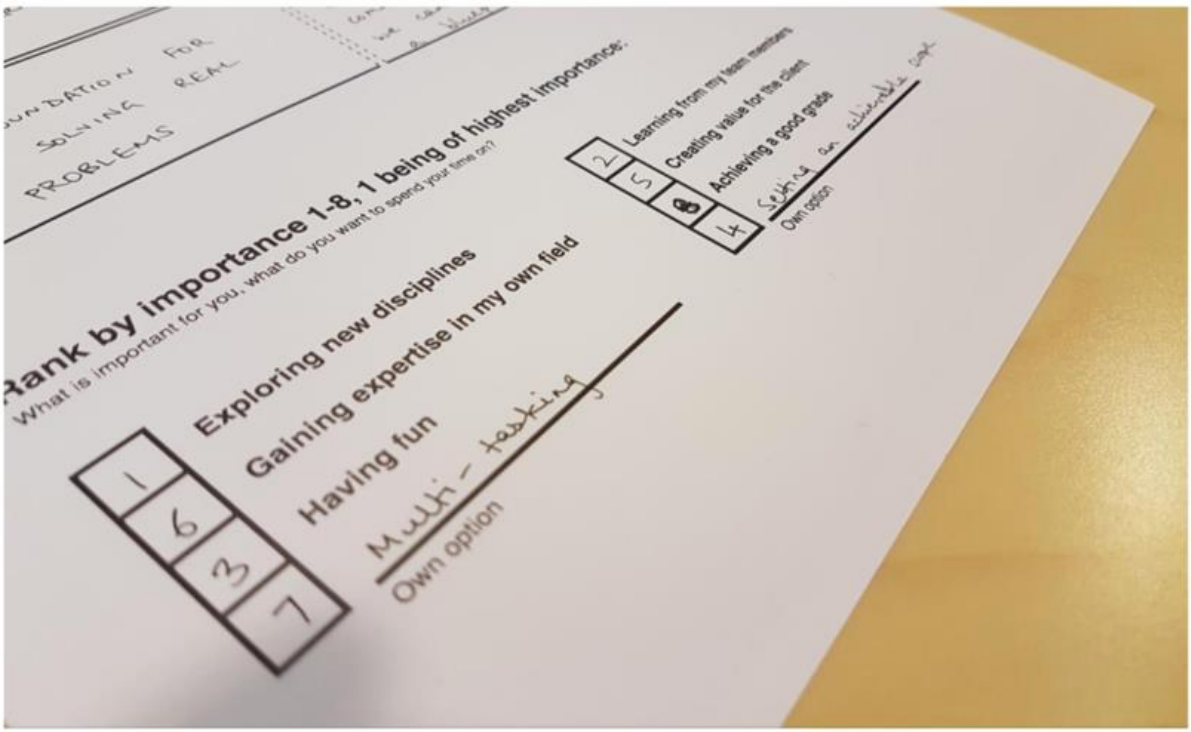

Figure 5. Participant reflecting on how rankings in the Personal Goal Setting documents were aligned within the team

'Meaningful' in this context was thus perceived as being able to get to know other people involved in the course (Figure 3), combine theory with practice (Figure 4), and reach aligned learning objectives for the course in the team (Figure 5) (in addition, there was a strong trend throughout the Personal Goal Setting documents illustrating how "Exploring new disciplines" and "Learning from my team members" were ranked higher than "Achieving a good grade"). Given that design often takes place in multidisciplinary settings, working with participants from other disciplines to achieve meaningful outcomes and experiences was something that helped the participants understand the interrelated relationship between design tools and designerly ways of knowing.

Furthermore, the excerpts from the participants' learning diaries described above illustrate how elements of the course, such as learning goals method, failure resume, and cooking slam served as potential triggers for transformation (as one of the participants wrote in their learning diary, "When I looked backed at my failures, I realized that many of past failures led me to become a better person now!"). In this context, sharing failures with others served two functions: first, it helped the participants to understand that their peers had experienced similar failures in the past, and second, identifying similarities by discussing a topic that is often avoided contributed to creating a sense of shared space within the teams.

Second aspect: Exploring ambiguity

While technology was perceived as creating – or dismantling – structures, exploring ambiguity refers to the participants reflecting on how different teaching methods and learning spaces enabled them to get to know their peers as well as locations situated outside the university premises. From design's point of view, such holistic exploration of ambiguity helped the participants to be more engaged with open-ended exploration. Given that ambiguity was so ingrained in the course, the participants regarded this as beneficial in terms of being comfortable with ambiguity. Moreover, due to the complex nature of the problem presented to the student teams, both contact sessions and online collaboration were geared towards the student teams exploring how they could frame both the problem and the solution space (as per Dorst & Cross, 2001).

In terms of describing and reflecting the problem and interpersonal ambiguity, the visual learning diaries illustrate how the participants experienced ambiguity to varying intensity throughout the course. One design student, for instance, summarised each of the three weeks as follows (Figure 6):

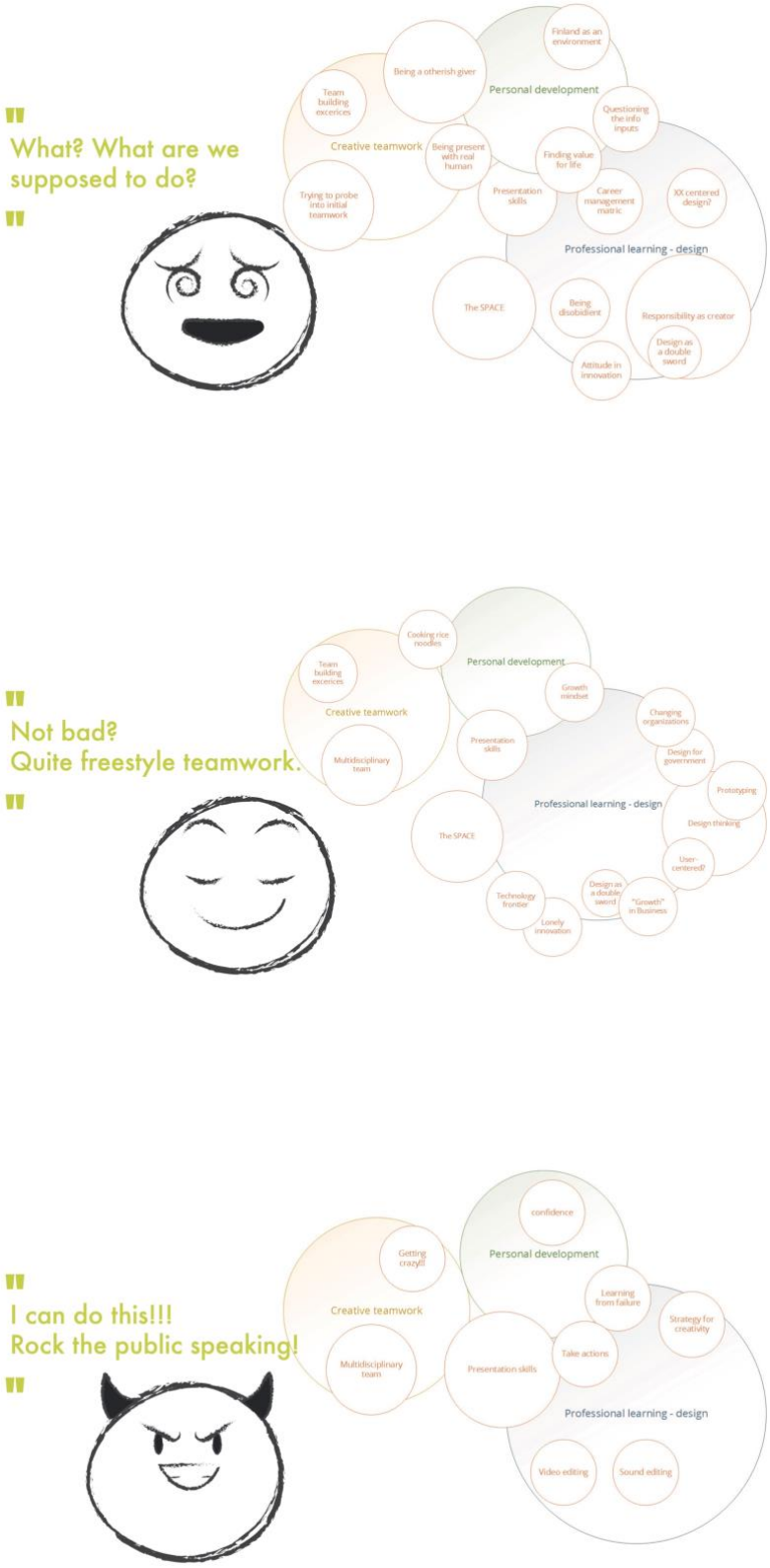

Figure 6. Three-week summary by one of the participants

After the first week the participant was reflecting on the diversity of topics covered during the week and how they all were connected. Moving to the second week, ambiguity was still present, although in a more manageable format, and ultimately during the final third week ambiguity had given way to execution. The same participant further elaborated on temporal ambiguity in their visual learning diary:

> *How am I supposed to tell my mother what happened in today's class?... To speak explicitly about the ambiguity during the design process might smooth the process for those especially not from a design background. I am familiar with either diamond model or this mess in the first phase of any design projects, but many of us might not.*

The excerpt above relates to the technological structures discussed previously in a sense that when the outcomes of the course are open-ended, structures and making them explicit are critical for the participants to deal with ambiguity. Put differently, dealing with ambiguity in a course context was perceived as manageable and at times even enjoyable by the participants, and distortions in the context or absent boundaries were seen as causing anxiety.

Third aspect: Technology as providing structure

One of the most recurring themes in terms of technology (i.e. online platforms and digital tools) in the learning diaries revolved around Microsoft's collaboration platform Teams. While some students enjoyed using Teams, majority of them felt it was confusing as a platform (Figure 7).

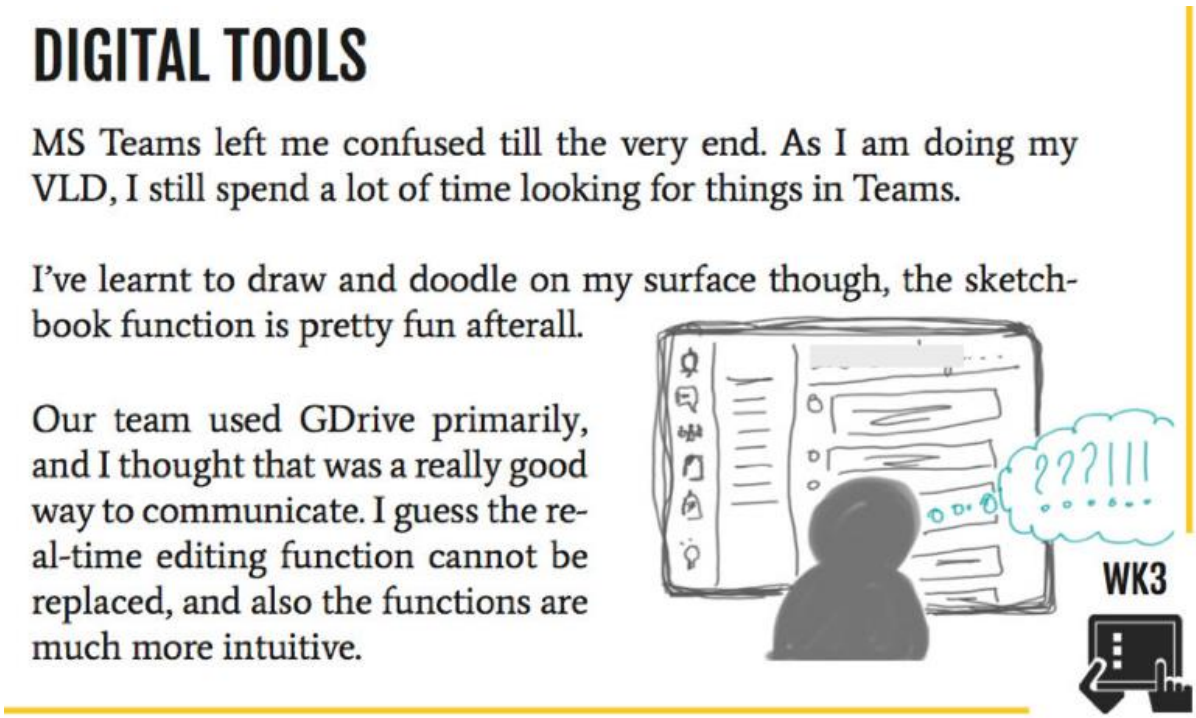

Figure 7. Participant reflecting on digital tools and especially Microsoft Teams

Microsoft Teams *per se* was not the problem, but how we as instructors had intended it could be used to facilitate collaboration between the students. Instead of providing the participants with guidelines on how to actively use the platform, we only created channels (e.g. "Course readings", and "Session slides") for storing material. While the students seemed to have

experienced no difficulties getting accustomed to the digital space, lack of adequate framing made it difficult to utilise digital tools to actively and collaboratively engage with the learning material. Given that design processes are often inherently ambiguous, findings here illustrate the need for more rigorous (though not limiting) structures when utilising digital tools in learning about design.

While the collaboration space was experienced by the participants as unstructured (Figure 8), the video and audio episodes were considered by many as either too long or detached from the learning outcomes.

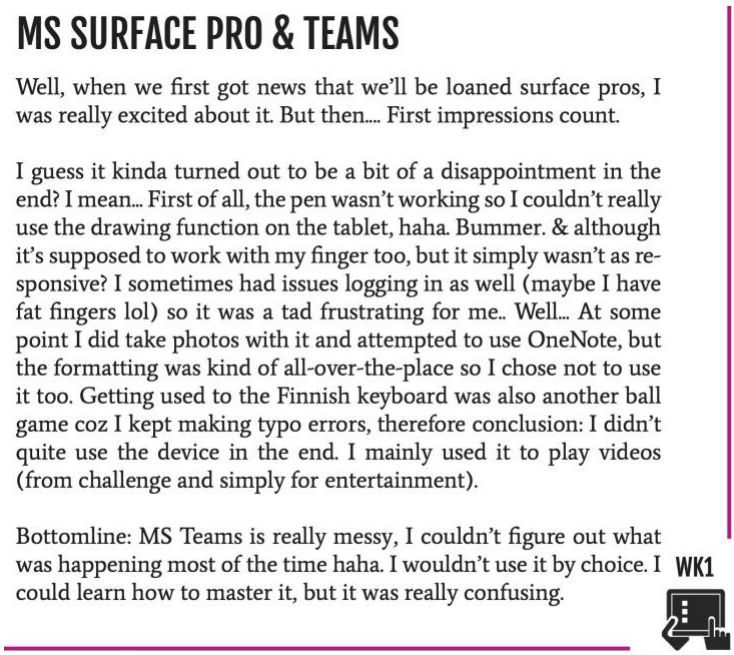

Figure 8. Participant reflecting on the digital tools

The participants did not question the content (e.g. multidisciplinary teamwork, individual strengths, design thinking, and design processes,), but frustration arose mostly from the episodes not having an explicit connection to the course contents and the lack of discussion about the episodes during the workshop sessions (as one of the participants wrote in their learning diary, "[t]here should be a particular session in which we reflect on online and offline sessions together and see what is the relations [sic] between and how they could support each other"). Conversely, lack of structure did not seem to be an issue in terms of organising the final event; another participant mentioned that they found it beneficial they "were not pre-given any structure or organising tips. This made each individual the most creative and collaborative". As such, from a course design perspective, structural ambiguities need to be mitigated so that students can develop their capacities for embracing ambiguity: "we cannot honor individual learning without simultaneously planning for the unexpected) (Lund Dean et al., 2022, p. 65).

Synthesising the three aspects: learning frame

Designing problem-based learning experiences in real-life settings implies a physical and mental departure from the university context, and the findings above illustrate that blended learning holds potential in teaching design to multidisciplinary student bodies. More specifically,

introducing blended learning aspects contributes to student agency whilst also allowing for more diverse approaches by going beyond the assumption that face-to-face learning is the most effective way to deliver design education across disciplines. Figure 9 describes how the findings are interconnected.

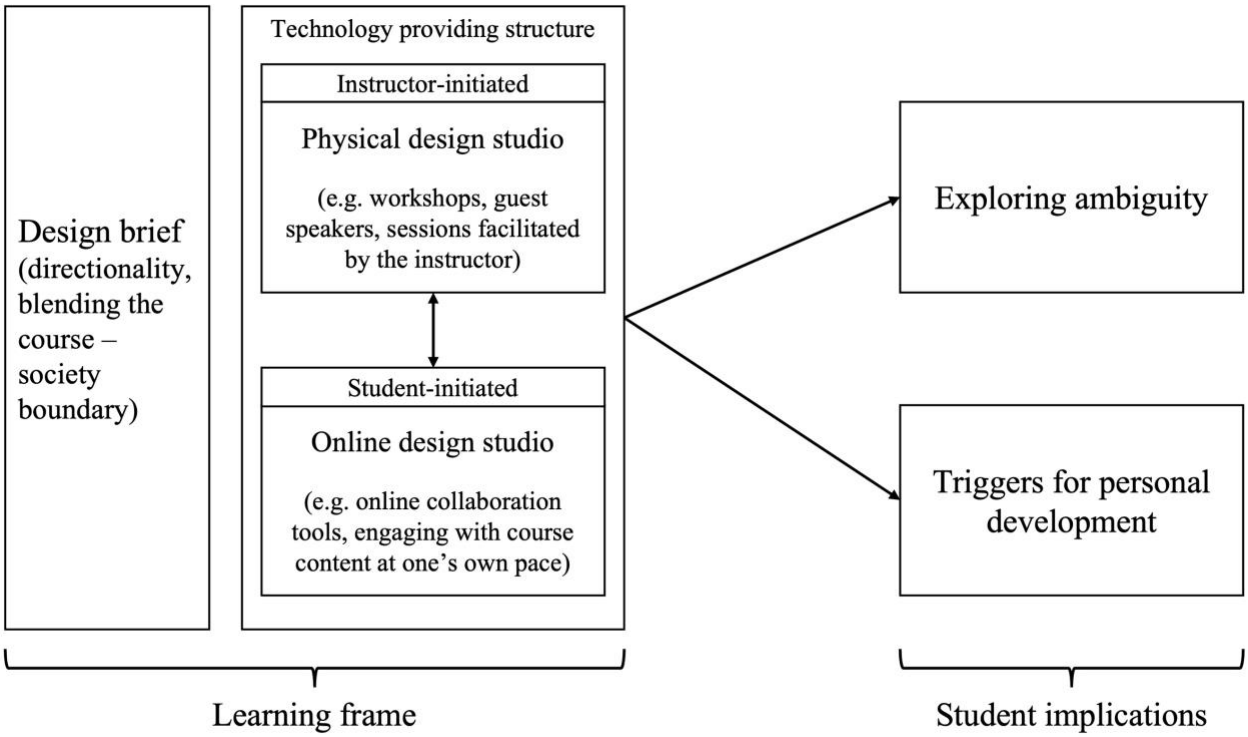

Figure 9. Framework for learning about design outside the design discipline

Learning frame, then, focuses on striking a balance between course activities initiated by the students and the instructor(s) (e.g. Lee & Anderson, 2013). In this regard, blended learning has the potential to create structures that provide more agency to the students, thus enabling them to explore ambiguity in the design brief's context as well as triggering reflections regarding personal development. Furthermore, blended learning has the potential to contribute towards crafting student-centric course by focusing on creating structures for the students to develop their design cognition (e.g. problem and solution framing) and competencies (application of tools and methods). In this regard, findings from this study illustrate how using blended learning technologies and methodologies can either hinder or support students' active learning about design. Lack of clarity, for instance, caused confusion and the audio-visual material being disconnected from the learning outcomes generated frustration, thus highlighting the importance of creating structures through the learning frame. Finally, findings presented above offer one vantage point for moving away from the physical-digital design studio dichotomy; by doing so, the concept of learning frame can be mobilised for creating learning environments that can positively contribute towards students' agency.

Discussion: blending technologies, disciplines, and contexts

Findings from this study contribute to discussions on teaching design outside the design studio (Brandt et al., 2013), making design more accessible (Lloyd, 2013), and design studio beyond the physical-digital dichotomy (Jones & Lotz, 2021; Lehtonen et al., 2021). Traditionally there

has been a tendency to equate design education as taking place in a physical design studio and often by focusing on teaching the students in confined spaces skills they might need after their graduation. By contrast, in the context of this study the participants were tasked with working on a design brief focusing on future and outer space as well as creating an event that was open for anybody to attend (in line with Sadowska & Dallas-Conte, 2017). This real-life anchoring seems to have the potential to serve two purposes: first, it enables reflection with regards to the outcomes and consequences of utilising design to frame problems and solutions, and second, it also allows for authentic feedback and reactions from potential users. Building on this, findings discussed earlier in this paper draw attention to aspects that did and did not work.

Starting with aspects that worked, ambiguity with regards to the design brief and personal reflections helped the students explore how design could be applied to societal issues. First, since blended and problem-based learning can give more responsibility and freedom for the students, they seem to be well suited in terms of dealing with the ambiguity rising from design projects' open-ended nature. In a similar vein, in the context of the course studied here, blended learning can transfer agency from the instructors to the students: that is to say, the instructor creates the learning environment, and the students carve their learning journeys within this environment. Given that we are expecting our students to embrace and manage ambiguity, we, as educators, should be doing the same by approaching course design as a design process in itself (in line with Lund Dean et al., 2022).

Second, as the findings highlight the emergence of exploration, both personal and professional, the importance of 'living learning' (Sadowska & Dallas-Conte, 2017) is reinforced when it comes to teaching design to multidisciplinary student groups. As prior research has suggested, designing in teams has the potential to help individuals acquire new insights and perspectives (Dong et al., 2013; Garbuio et al., 2018; Valkenburg & Dorst, 1998), and building on this, by interacting with the outside world in a course setting helps the students to acquire additional perspectives and insights. By providing the participants with a temporally and spatially distanced design brief (designing a concept for the future and dealing with the outer space), findings from this study support Lloyd's (2013) arguments on making design more accessible: instead of focusing on design as a managerial problem-solving tool, emphasising creativity and engaging with the world seemed to have helped the students to reflect on their professional identity and how design relates to it.

Conversely, aspects that did not seem to work focused on ambiguous structures and disconnections between online and offline content. First, while technology has the potential to provide structure, in the findings section above I discussed how students experience technology when structures are not present. Further, lack of structure seemed to have directed cognitive attention away from exploring ambiguity related to the design project in question towards trying to make sense of, and create structures to, the technologies utilised during the course. While learning to use critical tools and technologies is relevant, at the same time lack of structures is often detrimental to students' learning (as per Boelens et al., 2017).

Second, disconnections between digital content and activities in the physical domain also revealed how students' attention was diverted away from the actual content. For instance, Goodyear and Ellis (2008, p. 147) highlight how tasks, activities, and outcomes need to be aligned in blended learning, lest the way the course has been designed might divert students'

attention to less critical matters. Same holds true for assessment: “The teacher may espouse the intrinsic virtues of discussion, but if the assessment regime rewards signs rather than substance of engagement in discussion, the students will learn that token participation is more cost-efficient than deep engagement” (ibid., p. 149). Put differently, *why* specific content and activities are included in the course and *how* they relate to each other seems to be a critical issue especially when teaching design in blended learning environments.

Finally, the discussion above gives rise to two important implications. First, the study in question contributes to prior studies extending the design studio from its physical, often confined, domain by going beyond the physical – digital dichotomy (e.g. Jones & Lotz, 2021; Lehtonen et al., 2021). Purpose here is not to question the importance of physical spaces when it comes to design education, but instead to explore how and what aspects of design education could be delivered in blended learning format. As the Covid-19 pandemic has shown, it is possible to create courses that “retain the values of relationality, community-centredness” (Noel, 2021, p. 67), and findings from this study provide empirical insights into how learning about design in a blended learning environment can influence students’ approach to ambiguity as well as their self-reflections. As such, by dissolving the boundary between the physical and the digital in the design studio context, there is potential to create learning experiences that help students learn about design as a societal catalyst, become comfortable with ambiguity, and learn more about themselves and their peers. What is of importance here is to explore and reflect on what content and activities could be delivered online and what face-to-face, and consequently how to balance these two.

Second, the importance of student agency has also been highlighted. In their study on blended learning Moskal et al. (2013, p. 20) describe increased student engagement as one of the benefits, and as long as the structures are unambiguous and transparent (e.g. Lund Dean et al., 2022), convincing arguments can be made for teaching about design in blended learning environments. In the context of this study, for instance, technology was perceived as providing structures that hindered learning about design. Thus, conversely, identifying aspects where structures are necessary (and also irrelevant) helps in utilising technology in ways that benefit students’ learning. For example, O’Doherty (2020) discusses how films can be used to stimulate student creativity, and especially in blended learning contexts it should be made clear to the students *why* they are expected to watch videos and *how* they connect to the learning outcomes and other activities. Further, interesting avenue forward here would be to get student feedback on the syllabus and the learning activities prior to the course so as to ensure there are adequate connections between the course elements. In other words, what instructors perceive as evident might not be seen similarly by the students. Agency, then, seems to hold potential when considering how design education across disciplines could be delivered in blended learning format.

Conclusion and implications

The focus of this study was to explore how design education could be delivered in a blended learning format outside its disciplinary boundaries and with what kind of implications for students. Reasoning here being that prior literature seems to have equated design thinking (as design education outside design domain is often referred to) education with hands-on learning in a physical studio, yet as the Covid-19 pandemic has shown, it is crucial to explore other ways of designing learning experiences. To this end, the following research question was formulated:

How can blended learning support or hinder learning about applying design to societal issues and with what kind of implications for students?

In order to support students' learning about design, one potential avenue forward is to utilise the combination of real-life problems and blended learning, referred to here as the learning frame. Building on Kim et al.'s (2014) design principles, learning frame situates the learning outcomes in a broader context that benefits both students and teachers. In a similar fashion, by extending the design studio towards a learning environment that is more connected with the surrounding society, the students can become more exposed to the intricacies concerning designerly ways of working: as Lloyd (2013) suggested, design can serve as a catalyst for students to engage with the world and through this gain a deeper understanding of design cognition (e.g. Valkenburg & Dorst, 1998). In other words, blended learning seems to have the potential to support design (thinking) education by emphasizing students' agency over purely teacher-controlled learning environments.

In terms of practical and pedagogical implications, learning frame extends research on design education by illustrating the importance of providing the students with a conceptual anchor to contextualise the learning outcomes. In more concrete terms, I suggest introducing teaching and learning methods that contextualise the learning experience as well as trigger self-exploration. For instance, crafting a design brief that intentionally nudges the students to explore the world outside the classroom would help in gaining first-hand experiences in terms of dealing with ambiguity, while the visual learning diary serves as a relatively unconfined space for the students to explore their relationship to design. Furthermore, from the instructor's point of view, exploring ways through which to depart from top-down teaching towards community-driven learning is also beneficial as it has the potential to help students become active agents in their learning process.

Like any other academic inquiry, this study has its limitations that can be regarded as avenues for future research. First, as I have looked into what students perceive they have learned throughout the course, future studies could adopt a longitudinal approach or alternatively collect data from the students right after the course and after a certain time period. Second, two out of twelve teams joined the first two weeks remotely with a local facilitator, which is why comparative studies investigating how teams in different locations experience the same course could increase our understanding on how to teach design in online environments. Third, future inquiries could explore the affective dimension of blended learning; namely, what kind of emotions students go through when learning about design, and what role emotions might play in terms of increasing or decreasing student motivation. Finally, future inquiries could also investigate courses that are delivered fully online or alternatively compare similar courses across institutional and geographical contexts. In this study, I have focused on one institution located in Northern Europe, and as such future studies could explore the learning frame in other contexts so as to make it theoretically more inclusive and pedagogically more nuanced.

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