



Establishing psychological safety in online design-thinking education: a qualitative study

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Abstract

Design thinking, an approach traditionally used to develop or improve products, services, or processes within design and engineering sectors, has emerged as a novel pedagogical approach. As design thinking becomes more widely established within education contexts, it is important to gain deeper insight as to how such learning environments operate. The aim of this study was to explore online design thinking through the lens of psychological safety. We used a qualitative single-case study design to investigate nine students' experiences across a nine-week design-thinking project. Data were collected via semi-structured interviews and reflective journal entries, and analysed through reflexive thematic analysis. Our findings suggested that psychological safety is a valuable consideration in the design and implementation of online design-thinking learning environments. Facilitators of psychological safety included having collaborative environments, encouraging leadership, and a focus on team formation. Barriers to psychological safety included difficulties connecting, fear of speaking, and cultural considerations. Our findings also highlighted several outcomes of psychologically safe team climates, including creativity, collaboration, and the development of approaches to working with uncertainty.

Keywords Design thinking · Online learning · Online teamwork · Psychological safety

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Introduction

Design thinking is a team-based approach to problem solving that is used to develop products, services, or processes in industries such as design and engineering (Dam & Siang, 2018). In recent years, design thinking has been enthusiastically adopted across diverse higher education contexts, including business (Çeviker-Çınar & Demirbağ-Kaplan, 2017), computer science (Snow et al., 2019), information science (Clarke & Bell, 2018), law (Denvir, 2020), marketing (Lee & Benza, 2015), media (Lugmayr, 2011), and medical education (Badwan et al., 2018). The approach has also crossed over with ease into virtual learning environments, with higher education students now able to learn about, and through, design thinking in a variety of online settings (Alnusairat et al., 2021; Taheri et al., 2016; Wrigley et al., 2018), a phenomenon catalysed by the recent Covid-19 pandemic (Conrad & Farao, 2020; Victorino et al., 2021). Despite this surge of interest, there is limited research into online design thinking, and educators have little guidance as to what constitutes “best practice” in this domain (Zeivots et al., 2021, p.1362). With higher education’s increased reliance on technology, it is crucial that we use empirical methods to gain further insight as to how such novel learning environments operate.

Design thinking centres on “people not technology” (Zeivots et al., 2021, p.1362), and design teams must be able to collaborate effectively in online settings. Existing learning environments research highlights the importance of interaction, both educator-learner and learner-learner, in the development of group processes in online settings (Bryceson, 2007; Swan, 2002). Furthermore, online environments that nurture a sense of belonging and closeness between learners and teachers can provide fertile grounds for effective collaboration (Durgungoz & Durgungoz, 2022; Polat & Karabatak, 2022).

Studies have also highlighted the importance of psychological safety, which is “the degree to which people view the environment as conducive to interpersonally risky behaviors like speaking up or asking for help” (Edmondson et al., 2016, p. 66), in building connections within online learning environments (Bonk et al., 2004; Zhang et al., 2012). Team members who experience psychological safety are thought to engage more readily in creative or innovative work (Edmondson & Lei, 2014; Henriksen et al., 2020; Wolcott et al., 2021). Psychological safety has been studied in a wide variety of physical learning environments including clinical medical education (McClintock et al., 2021), experiential learning (Ayub et al., 2022) and simulation-based settings (Kang & Min, 2019). Although a growing number of researchers are turning their attention to psychological safety in online learning environments such as digital gaming (Mayer, 2018) and virtual debriefing (Dickinson et al., 2021), there appears to be a lack of research on its role in online design thinking. The aim of this study was to apply a lens of psychological safety to this novel pedagogical approach, and examine design team members’ experiences of sharing ideas, making mistakes, taking risks, and discussing problems (Edmondson & Lei, 2014) in the online setting. Our research questions were: (i) can psychological safety be facilitated in online design thinking?; and, if so, (ii) what factors help or hinder the establishment of psychological safety in online design-thinking teams and (iii) what outcomes of psychological safety can be recognised.

Methods

Study design and theoretical perspectives

This pilot study forms part of a larger design-based research project that aimed to design, build and test a digital educational escape room that helps medical students to manage uncertainty. Design-based research (DBR) is “a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings” (Wang & Hannafin, 2005, p. 6). Importantly, DBR projects allow researchers to design and test developments or interventions in naturalistic settings, whilst also advancing understanding of contemporary theoretical issues (Barab & Squire, 2004). Here, adopting a DBR approach allowed us to explore the online design-thinking learning environment through the lens of psychological safety whilst developing a practical educational resource. We used a qualitative single case study design (Harrison et al., 2017) that was grounded within a constructivist paradigm (Lee, 2012). The study has been reported in accordance with Tong et al. (2007) Consolidated Criteria for Reporting Qualitative Studies (“Appendix A”).

Context and participants

In the summer of 2021, an online design-thinking project was hosted at RCSI University of Medicine and Health Sciences, a culturally diverse, international institution with over 4,000 students from 90 different countries. The project was facilitated by the university’s STEP (Student Engagement and Partnership) initiative, which aims to promote staff–student collaboration. One staff member and one final-year medical student led the project, and nine further student places on the design team were advertised through online, student-led social media channels. The project was open to all medical students enrolled at the university, and participants were selected purposively via submission of a written personal statement that probed students’ interest in, and experience of, digital game-playing.

Over a nine-week period, the design team followed a five-phase process of design thinking (d.school, 2019) to address the design challenge: “How might we use a digital educational escape room to help medical students to manage uncertainty during transitions into the clinical setting?” Each week, the full design team met online for a synchronous ‘design huddle’ facilitated by web-conferencing software (Zoom; San José, USA). During these sessions, team members engaged in a wide range of design activities including theme building, story boarding, puzzle making, and affinity mapping. Between the full-team sessions, the students met in small groups, allocated according to their broad geographical location (North America, Europe, Asia) to engage in further design activities, including game-user interviews, escape game sessions, and game testing. Finally, the students also took part in individual activities such as puzzle making and journal writing throughout the duration of the project. Online design activities were facilitated by several technologies including Miro (San Francisco, USA), Padlet (San Francisco, USA), and Moodle (Moodle HQ; Perth, Australia). Overall, the five-phase design-thinking process resulted in the development of a prototype digital educational escape room. All nine students on the design team were invited to take part in this study on a voluntary basis. All students agreed to take part and provided their written consent.

Data collection

The study used methodological triangulation (Korstjens & Moser, 2018) by gathering data through two methods: semi-structured interviews and reflective journal entries (Jasper, 2005) (Fig. 1). The semi-structured interviews were held in the final week of the project, and used an interview guide (“Appendix B”) that incorporated questions aligned to existing measures of psychological safety (Edmondson, 1999) and which was developed in accordance with suggestions made by Kallio et al. (2016). The interviews were conducted by a facilitator not connected to the study with the aim of reducing the likelihood of students giving responses that “the interviewer wants to hear” (Diefenbach, 2009, p. 881). Interviews were held online with a duration ranging between 25 and 60 min. These were video-recorded and the audio component transcribed. The weekly journal entries, submitted through Microsoft Forms (Redmond, USA), captured the participants’ reflections on their experiences using trigger questions such as: “What are you feeling at the start of this project?”; “How would you describe the team climate or atmosphere on this project so far?”; “What are you learning about your own responses to uncertainty in this project so far?” These journal entries allowed participants to share perspectives on the project within a different context and across a longer time-line, aiming to avoid a “snapshot” approach to data collection (Diefenbach, 2009, p. 883).

Data analysis

The data-sets derived from the transcribed interviews and the journal entries were combined and organised using NVivo 12 (QSR International; Melbourne, Australia). The data were analysed through reflexive thematic analysis (Braun et al., 2018), an approach which allows researchers to identify themes that are “conceptualised as patterns of

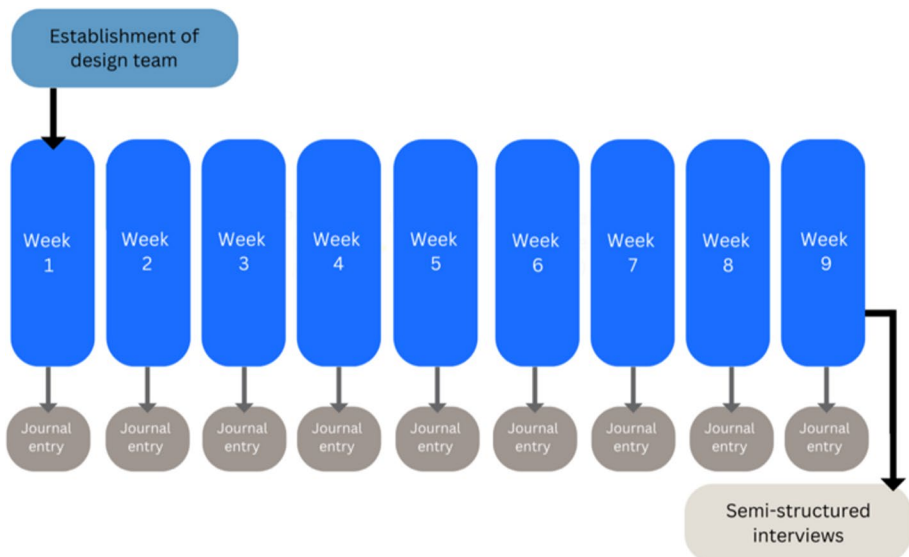


Fig. 1 Study design flowchart and data collection

shared meaning underpinned by a central organising concept” (Braun & Clarke, 2021, p. 39). This entailed a six-phase process: familiarisation with the data; coding; searching for themes; reviewing themes; defining and naming themes; and writing up. The researchers used an inductive approach to identify codes and themes within the data. However, deductive analysis was also used to ensure that codes and themes were relevant to all three of our research questions. The researchers used both semantic and latent coding to analyse the data, and it was possible for data to be double-coded. The analysis was primarily conducted by JM with input from RL in sense-checking codes and themes.

In the first phase, JM read and re-read the data several times to familiarise herself with the content. Notes of potential codes, initial trends and negative cases were made on printed versions of the data. Second, JM generated initial codes using an open-coding approach, making several passes through the data. Third, JM and RL explored the content of the codes with the aim of identifying candidate themes that could express their common content, and assess their relationships between codes and themes. During this phase, codes were also revised where necessary. Fourth, the themes were modified and codes were re-organised resulting in some themes merging and others re-named. This resulted in an initial set of themes and sub-themes. Fifth, the themes were defined and named by identifying the ‘essence’ of what each theme was about. In the sixth and final phase, we revisited the research questions, notes, and codes, to ensure that the final themes represented a close match with the original data and could be mapped back to the initial research questions with accuracy. The final themes and sub-themes identified through the analytical process are presented in the results below.

Results

Nine participants (five female undergraduate medical students; three male undergraduate medical students; one female graduate-entry medical student) engaged in the weekly journal activities, resulting in 51 unique pieces of reflective writing. Eight participants took part in the semi-structured interviews (one participant was not available).

The data were analysed with respect to the research questions: (i) can psychological safety be facilitated in online design thinking?; if so, (ii) what factors help or hinder the establishment of psychological safety in online design-thinking teams?; and (iii) what outcomes of psychological safety can be recognised? The following themes and sub-themes (Fig. 2) were identified:

- Indicators of psychological safety (sharing ideas, taking risks, making mistakes, asking for help);
- Facilitators of psychological safety (collaborative environment, encouraging leadership, team formation);
- Barriers to psychological safety (difficulties connecting, fear of speaking, cultural considerations); and
- Outcomes of psychological safety (creativity, collaboration, working with uncertainty).

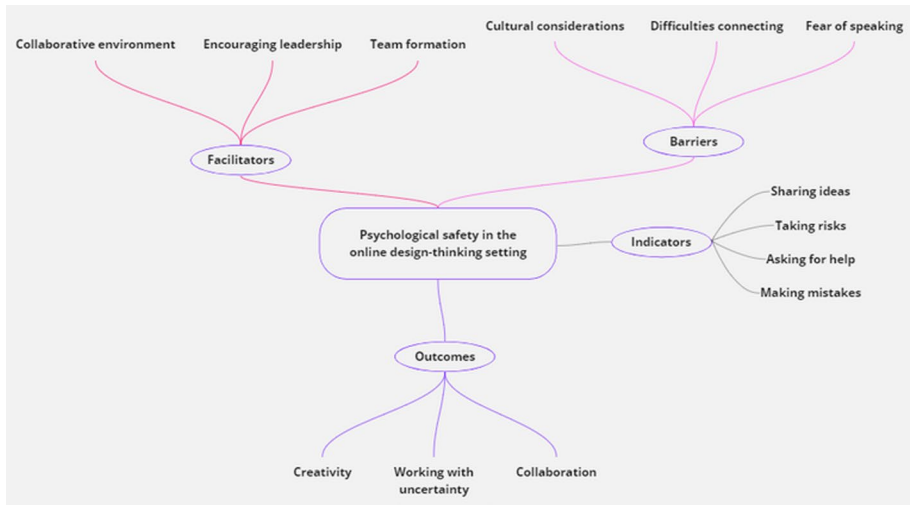


Fig. 2 Themes and sub-themes identified through the analytical process

Indicators of psychological safety

Data analysis suggested that psychological safety can be facilitated within online design thinking (research question 1), with several indicators of the construct recognisable within the data. These indicators were categorised according to sub-themes: sharing ideas; taking risks; making mistakes; and asking for help. The participants spoke at length about the ease they felt in sharing ideas and opinions during online sessions. They felt comfortable taking part in team discussions and were able to offer alternative perspectives. They also felt safe to ask questions. Multiple comments related to how the participants felt heard by the rest of the team and that their ideas were valued. Overall, participants expressed that they felt respected and understood:

I felt like you could speak freely... and it wasn't like you know, sometimes you kind of throw ideas out and someone can kind of shut you down. I didn't feel like that's what it was. I felt like if you threw something out there, it was taken into consideration. [SP445]

Participants also felt comfortable in taking risks during the intervention. They identified several aspects of online work that they considered “risky”. These included speaking up during online sessions, offering creative work for evaluation, and sharing ideas. With regards to the latter, participants expressed a “fear of failure”, (i.e., that their ideas would not be liked or deemed of sufficient merit by others). Despite these fears, the participants felt safe to “step outside of the comfort zone” and discuss ideas, even those that could have been considered unconventional:

Any sort of weird, wacky, outlandish ideas or thoughts that we had, we would just say them. And there was no judgement from anybody else in the group... So anything that we said, even if it was a bit out of bounds, was still completely fine. [SP836]

The participants also reported feeling safe to give, elicit and receive feedback without feelings of criticism. They also felt equipped to offer suggestions for change and address mistakes within the project. The participants highlighted that making change was easy, and did not involve intense emotional frustration:

So at one stage, we had to all send in puzzles, and then two other team-mates would look at it and give evaluations. Well, it didn't feel bad to ask 'OK, what can make it better?', 'What didn't work?', 'What could I change to make it easier for a player to understand?' [SP050]

Finally, the participants commented that they felt equipped to ask for help as they became more familiar with each other. They sought help both during the synchronous online sessions and via asynchronous channels. One participant highlighted that the safety she experienced within the project encouraged her to engage in "help-offering" as well as "help-seeking" behaviour:

If it weren't for [Facilitator 1] being so friendly and being so open to crazy ideas... I wouldn't have personally emailed her asking if, you know, she if she wants any help from me. Since I like doing art, maybe I could find illustrators or work with an illustrator to help create an illustration? [SP421]

Facilitators of psychological safety

The participants highlighted several factors that could help the establishment of psychological safety in online design-thinking teams (research question 2). These were arranged into three sub-themes: collaborative environment; encouraging leadership; and team formation.

There were many comments on the influence of the online learning environment. The participants spoke about the importance of the weekly, full-team online sessions in becoming more familiar with each other. They noted that "getting to know each other" was important with respect to building psychological safety. Regular ice-breakers (e.g., online polls and activities) were valued as helpful. They were also particularly positive about break-out rooms (i.e., technology that divides a large group of individuals into smaller, private sub-groups online) which allowed them to share ideas in a low-stakes way. One participant commented that she considered the number of people in the full-team sessions, normally 11–12 participants, as "massive". Another participant highlighted that choices around how to communicate during the full-team sessions (e.g., by using voice or text-chat communication and to keep cameras on or off) helped her to share ideas:

Bonding with other group mates during either sessions or group work makes me feel more connected, and once I feel more connected then I feel more comfortable sharing and asking in the group! [SP246]

Getting to know people better by interacting with them via the small group sessions... made me feel comfortable sharing my ideas and discussing more openly. [SP330]

The participants highlighted that small group activities provided opportunities for more informal communication and relationship building. Social activities such as playing online games together were valued. In addition, they liked that the groups had been organised by time zone, which made synchronous communication easier.

The participants also spoke about the central role of the project facilitators in establishing psychological safety. A range of different leadership skills was mentioned, including

effective communication, keeping the team on task, and creating a safe space to draw ideas out. Specifically, the use of supportive language (“encouraging words”) and communication approaches helped participants to feel validated. Facilitator attitudes of “openness” and “friendliness” contributed to the experience of psychological safety. Participants felt that such approaches helped them to transcend a perceived hierarchy between the student team members and the facilitators as “seniors”:

I think what helped is that [Facilitator 1 and 2] didn’t make it seem like they were our seniors in a sense. They made us feel like we were all one group and we were all at the same level, we shouldn’t be fearful of them in a sense, because sometimes, you know, you see heads of the project and it’s kind of scary. But from the first day they established that, you know, this was a safe environment and they wanted to hear all of our ideas and that they really wanted us to pitch in. [SP445]

Team formation was also considered important. Participants remarked that it took time to feel comfortable with each other. It was considered that a positive start to the project (e.g., through co-creating guidelines on how the team would work together) was helpful. They also commented on the open, supportive and non-judgemental communication of team members in both synchronous and asynchronous channels. Overall, team formation culminated in an atmosphere characterised by warmth, humour and informality:

I think the biggest component to encouraging the sharing of ideas and creating a safe space is the atmosphere our group has created. From the beginning, we all agreed on a series of guidelines for open communication; it was nice being able to explicitly go over that. Going forward, all of our group members were friendly and encouraging. I believe that mentality made me feel comfortable speaking up and gave me a sense of ease. [SP445]

Barriers to psychological safety

Participants also described several factors that could hinder the establishment of psychological safety in online design-thinking teams (research question 2). These were arranged in three sub-themes: difficulties connecting; fear of speaking; and cultural considerations. Participants highlighted challenges in building relationships in the online environment. Some felt that face-to-face meetings would have helped them to develop richer social relationships, as well as to progress more quickly through collaborative tasks:

I feel like [a face-to-face setting] would have been be much more collaborative because you can sit around with each other and discuss with each other. And at the end of the day, when you’re done with the work, you can just grab some coffee and then deepen your friendship. [SP330]

Others commented that it was difficult to engage in one-to-one conversations during the full-team sessions compared with a face-to-face setting. Having cameras off, noted several participants, could lead to a lack of engagement. Similarly, there were times when they struggled to find the right moment to enter into a discussion during synchronous conversations.

A fear of speaking in the online setting was also observed. Many participants mentioned a general nervousness about interacting online. Making comments, asking questions or using “raise hands” tools were all considered risky. The participants referred to a tendency

towards “shyness” with regards to online meetings. Overall, the participants preferred small groups over large groups:

I guess, I’m not like a super talkative person, so like even just like in during the workshop, like stepping out to just start talking is a step out of my comfort zone. [SP246]

Finally, there were comments about how language and cultural differences may act as a barrier to the establishment of psychological safety. For example, one participant commented that being a non-native English speaker could interfere with her conversations with teammates. Cultural considerations concerning the formal or informal nature of communication were also highlighted, with one participant voicing hesitation about using more informal types of communication when the facilitators were involved.

Outcomes of psychological safety

Finally, a number of outcomes of psychological safety were observed within the data (research question 3), and these were arranged into three sub-themes: creativity; collaboration; and working with uncertainty.

The participants noted how psychological safety helped them to engage in creative behaviour. They described a process for which they felt safe to generate and share ideas. They were also able to build on each other’s ideas, finding synergies in their work. Despite a sense that creative work was risky and at times difficult, the participants felt that they could overcome blocks in their imagination and sit with discomfort during the creative process:

When I started, I was like, ‘How are we going to do this?’... But it was just interesting to see how us doing these tasks every week... we just made this whole product and I was like ‘Wow, I have no idea how this came together!’ [SP445]

The participants also highlighted that psychological safety helped them to collaborate more fully as a team. It was acknowledged that they often worked interdependently and autonomously during the project. They described being able to engage in problem solving and task switching with ease. They were also able to manage differences of opinion or conflict:

I think there was definitely times where I was having a problem or there was something I couldn’t figure out how to do, and I was able to get kind of feedback from like my other team-mates and they were like ‘Oh this person did this. Maybe you could try this?’ or ‘This was something that I had done and maybe this could help you figure this out?’ [SP445]

Whilst there were many comments about uncertainty in relation to the overall goal of the design-thinking intervention, an online escape game that would help medical students to manage uncertainty, these were not deemed relevant to the research questions. However, the participants also discussed experiences of managing uncertainty within the design-thinking process itself. They noted many uncertainties including how the project would run, engaging in new activities, the workload involved, and the quality of their ideas and creative work:

Every time we are tasked to do something new or unfamiliar (i.e., interviewing someone/ making a puzzle), I still get butterflies in my stomach. But as the project

progresses, I realised I'm getting more comfortable with the tasks, especially with the help of my kind group-mates. The safe environment that this project provides also helps me deal with those uncertainties too. [SP100]

During this project my response to the arising uncertainties doesn't feel as anxious or nerve-racking as they usually do. I believe this is due to the comfort level I have developed amongst the group where I don't feel judged for my thoughts and ideas. [SP445]

Discussion

This study sought to provide insight into the role of psychological safety in online design-thinking learning environments. Our results suggest that psychological safety can be nurtured in such settings, enabling student design team members to share ideas, speak up and ask for help. The data also indicate that our participants experienced psychological safety despite perceiving multiple uncertain and anxiety-inducing moments when engaging in creative, team-based activities. Their excitement at taking part appeared to be tempered by apprehension, especially when exposing their ideas or work to others. Such experiences are commonplace when students engage in creative processes, and authors recognise that “exploring new possibilities and producing novel ideas and behaviors” can evoke anxiety for some (Daker et al., 2020, p. 4) This extends to design-thinking settings that invite students to “abandon comfort zones” (von Thienen et al., 2017, p. 306) and engage with a wide range of emotions (Elsbach & Stigliani, 2018; Kavousi et al., 2020).

Our findings also suggest that students experience a sense of risk in relation to interacting online. Many participants expressed nervousness around offering ideas or asking questions during online synchronous sessions. Although they reported feeling able to speak up during online meetings, it took time to reach this state of psychological safety. This supports previous research that highlights students' discomfort with synchronous activities which require “spontaneous and skilled responses ‘on the fly’” (Kamalou et al., 2019, p. 11), potentially exacerbating existing worries around social interaction and contributing to so-called “zoom anxiety” (Ngien & Hogan, 2022). Our findings support the idea that, although higher education students are often characterised as “digital natives”, online learning environments may not, by default, represent natural habitats for all. It appears that online design thinking, which involves risky, creative, team-based learning in a risky online environment, places students in a unique space of shared vulnerability. This reinforces the notion that psychological safety holds value for online design-thinking education, enabling design teams to collaborate effectively.

Whilst psychological safety appears simple, it is not easy to achieve (Edmondson, 2002), and effort is required in generating an environment where individuals feel empowered to raise concerns or ask questions. Newman et al. (2017) highlight several antecedents of psychological safety including supportive leadership, team relationships and organisational practices. Our data support these factors and offer insight about practical ways in which psychological safety can be facilitated in online design-thinking settings. For example, synchronous online sessions helped students to “get to know each other”, a process that was deemed essential to establishing psychological safety. More specifically, break-out rooms facilitated the building of trust and relationships. The value of break-out rooms in establishing social connections has been highlighted by others (Fitzgibbons et al., 2021).

The participants also spoke at length about the value of effective leadership. They indicated that team facilitators helped to lay the foundations for psychological safety through attributes and skills such as openness and supportive communication. These findings mirror the broader literature that acknowledges “the salience of the direct leader in shaping the work context and crucial role leaders play in fostering psychological safety” (Frazier et al., 2017, p. 140). This becomes especially important when staff and students engage in collaborative design processes to the backdrop of hierarchical environments such as medical education (Henriksen et al., 2020). Although participants expressed comfort in working with the facilitators, they continued to use differentiating terms such as “seniors” to categorise them. This suggests that there may be scope to offer further communication options for which the facilitators are not present, as this may lead to more fluid conversations between peers.

The role of the facilitator is particularly important in online settings. When students engage in face-to-face design-thinking projects, they often operate in a physical design space with visual cues to help them to transition into a creative mindset. Such visual cues are less available in the online setting, placing an onus on facilitators to “[set] the stage for creativity, encouraging the energy and social connection that makes in-person learning engaging” (Zeivots et al., 2021, p. 1361). Furthermore, facilitators also need to help online design-thinking students to become confident users of technologies that are, at times, “unreliable, difficult and cumbersome” (Kvan, 2001, p. 349). It is likely that facilitators’ verbal and non-verbal communication skills are of critical importance in addressing these challenges.

Another factor that can facilitate psychological safety is team formation. Our participants noted that an investment of time and effort in setting the scene for group-work had helped. They valued the opportunity to contribute to a set of guidelines as to how the team would work together, as well as to engage in social activities and ice-breakers. This is supported by existing literature that highlights the importance of cultivating trust between students when establishing collaborative online learning environments (Beranek & French, 2011; Tseng et al., 2019). Positive, supportive communication between the individual team members also proved important, and the participants valued a team climate that was non-judgemental, and mediated through respectful communication, despite extended periods of giving and receiving feedback within the group. The team were able to offer each other tangible, problem-solving support. The central role of such peer support in establishing psychological safety has been highlighted in the literature (Frazier et al., 2017). Also of note was an apparent timeline with regards to the establishment of psychological safety. This did not happen immediately; participants felt that it took time before they felt safe enough to share opinions and ask questions. Although there is limited research around this dimension of psychological safety, authors suggest that it likely “takes time to build, through familiarity and positive responses to displays of vulnerability and other interpersonally risky actions” (Edmondson & Lei, 2014, p. 38).

Our findings also suggest factors that can hinder the facilitation of psychological safety in online design-thinking learning environments. For example, some participants considered that the lack of face-to-face activities meant that there were less opportunities for ad hoc social interactions, which may have led to the development of deeper relationships. They missed spontaneous one-to-one conversations during the main sessions, and the ability to “grab a coffee” afterwards. This suggests that attention should be paid to relationship building in the design and implementation of online design thinking (e.g., through providing students with opportunities to engage in “unscripted”,

informal meet-ups outside of the formal schedule), a consideration that is supported by the wider learning environments literature (Biccard, 2022; Valtonen et al., 2021).

Finally, we also recognise a series of outcomes that arise from the establishment of psychological safety in the online design-thinking setting. Our team reported that they felt better equipped to collaborate with each other, engage in creative processes, and build approaches to managing uncertainty. Ultimately, team members were able to broach the risks mentioned above and share ideas and engage in feedback behaviour. This meant that they could suggest and make changes with relative ease. Again, these findings align well with the existing literature that highlights links between psychological safety and team outcomes such as innovation, creativity, performance and learning (Newman et al., 2017).

During the intervention, the students also learned about uncertainty. This was not unexpected since the overall aim of the project was to design, build and test a digital educational escape room that facilitated learning around uncertainty. However, there were a surprising number of comments that related to the design-thinking process rather than the escape room itself. Participants reported that they had become “comfortable with discomfort”, and could move forward despite being faced with ambiguous or complex information. It is likely that such growth came through analysing multi-layered, complex information and engaging with multiple aspects of game design, where no clear “black or white” solution existed. The literature supports the idea that design-thinking education provides a natural environment for experiences of uncertainty. Through engaging with the process, students meet a “seemingly never-ending sources of ambiguity resulting from the indeterminacy of the design process and the equivocality it evokes” (Welsh & Dehler, 2013, p. 788). Thus, design thinking provides a valuable opportunity for students to develop constructive approaches to working with uncertainty (Glen et al., 2015). Although our overall project set out to create a learning resource that helps medical students to engage with uncertainty, it is likely that the process itself—design thinking within the context of a psychologically safe team climate—enabled our students to reach that goal in a different way. Our findings support the idea that “helping students to think like designers may better prepare them to deal with difficult situations and to solve complex problems in school, in their careers, and in life in general” (Razzouk & Shute, 2012, p. 343).

Strengths and limitations

Our study offers an opportunity for educators to deepen their understanding of the role of psychological safety in online design-thinking learning environments. Our findings provide insight as to how psychological safety arises in such settings, including those factors that help or hinder its establishment. There are, however, limitations to the study. As a pilot study with a purposive sampling method, our cohort was small and included students from a single discipline, namely, medical education. In addition, our students had gone through a competitive process to gain a place on the design team and, hence, were probably highly engaged with the project and its goals. This creates a unique study context, and our findings should be interpreted accordingly. Future work that examines psychological safety in different online design-thinking settings (e.g., studies that specifically explore the experiences of multi-cultural design teams that include students)

would be highly valued. We also support Edmondson and Lei's (2014) call for greater research into how psychological safety evolves in teams over time.

Conclusion

The aim of this study was to make an initial exploration of the role of psychological safety in an online design-thinking learning environment. Our findings suggest that psychological safety can be established in online design teams, and is a valuable construct that supports students to overcome the multiple risks they perceive when engaging in creative, online team-based work. There are multiple facilitators of establishing psychological safety in such settings including a collaborative environment, encouraging leadership, and an attention to team formation. There are also several barriers (e.g., difficulties connecting, fear of speaking, and cultural considerations). Our findings also suggest that psychological safety can help online design teams to establish creativity, collaboration, and build approaches to working with uncertainty. Finally, this study offers guidance to educators who wish to design and implement online design-thinking learning environments, and support design teams that include higher education students.

Reflective statement

All members of the research team have expertise across health professions' education. JM is a faculty developer with a research interest in online learning, teamwork and management of uncertainty in health professions' education. RL is a final-year medical student with expertise in teamwork and psychological safety. JI is a health professions' researcher with expertise in qualitative methodologies. MACF is a health professions' education researcher with expertise in qualitative methods, faculty development, and critical pedagogy. HB is a researcher in health professions' education with expertise in assessment, feedback and workplace learning.

Appendix A: Consolidated criteria for reporting qualitative research (COREQ): 32-item checklist

No	Item	Guide questions/description	Reported
<i>Domain 1: Research team and reflexivity</i>			
Personal characteristics			
1	Interviewer/facilitator	Which author/s conducted the interviews?	Interview guide developed by JM. Interviews conducted by independent facilitator
2	Credentials	What were the researcher's credentials? <i>e.g. PhD, MD</i>	Yes
3	Occupation	What was their occupation at the time of the study?	Yes
4	Gender	Was the researcher male or female?	Not reported

No	Item	Guide questions/description	Reported
5	Experience and training	What experience or training did the researcher have?	Yes
Relationship with participants			
6	Relationship established	Was a relationship established prior to study commencement?	Not reported
7	Participant knowledge of the interviewer	What did the participants know about the researcher? <i>e.g. personal goals, reasons for doing the research</i>	Yes
8	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? <i>e.g. bias, assumptions, reasons and interests in the research topic</i>	Not reported
<i>Domain 2: Study design</i>			
Theoretical framework			
9	Methodological orientation and theory	What methodological orientation was stated to underpin the study? <i>e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis</i>	Yes
Participant selection			
10	Sampling	How were participants selected? <i>e.g. purposive, convenience, consecutive, snowball</i>	Yes
11	Method of approach	How were participants approached? <i>e.g. face-to-face, telephone, mail, email</i>	Yes
12	Sample size	How many participants were in the study?	Yes
13	Non-participation	How many people refused to participate or dropped out? Reasons?	Yes
Setting			
14	Setting of data collection	Where was the data collected? <i>e.g. home, clinic, workplace</i>	Yes
15	Presence of non-participants	Was anyone else present besides the participants and researchers?	Yes
16	Description of sample	What are the important characteristics of the sample? <i>e.g. demographic data, date</i>	Yes
Data collection			
17	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Yes, "Appendix B"
18	Repeat interviews	Were repeat interviews carried out? If yes, how many?	No
19	Audio/visual recording	Did the research use audio or visual recording to collect the data?	Yes
20	Field notes	Were field notes made during and/or after the interview or focus group?	No
21	Duration	What was the duration of the interviews or focus group?	Yes
22	Data saturation	Was data saturation discussed?	No

No	Item	Guide questions/description	Reported
23	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
<i>Domain 3: analysis and findings</i>			
Data analysis			
24	Number of data coders	How many data coders coded the data?	Yes
25	Description of the coding tree	Did authors provide a description of the coding tree?	No. Information on themes and sub-themes is provided (Fig. 2)
26	Derivation of themes	Were themes identified in advance or derived from the data?	Yes
27	Software	What software, if applicable, was used to manage the data?	Yes
28	Participant checking	Did participants provide feedback on the findings?	No
Reporting			
29	Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? <i>e.g. participant number</i>	Yes
30	Data and findings consistent	Was there consistency between the data presented and the findings?	Yes
31	Clarity of major themes	Were major themes clearly presented in the findings?	Yes
32	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes

Developed from: Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, 19(6), 349–357.

Appendix B: Interview guide

Project title: The novel use of an educational escape room to develop learners' capacity to manage uncertainty during medical school transitions

Opening

Thank you for agreeing to take part in this interview, it is much appreciated. My name is [introduces self and explains role]. I am going to ask you some questions today about your experiences on the RCSI escape room project, which mostly relate to teamwork and uncertainty.

The interview should take about 45 min and will be recorded via Zoom. You don't need to have your camera on if you don't want to as we will only need the audio part of this

interview. The recording will be transcribed into text and your opinions will be collated into a group response along with your other teammates on the project.

Can I first check that you were able to access and fill in the consent form? Do you have any questions about anything before we begin?

Questions

What did you like most about taking part in the escape room design project?

What did you like least about taking part in the escape room design project?

Did you learn anything about uncertainty when taking part in this project? If so, what was this?

Did you feel uncertain about anything as you took part in the project? If so, what was this?

How would you describe the team climate or atmosphere on this project?

How would you describe team communication during this project?

How were mistakes managed during this project?

How were problems or tough issues managed during this project?

How were differences of opinion managed during this project?

Did you feel safe enough to take risks on this project? If so, what helped here?

Did you feel safe enough to ask for help when you needed it on this project? If so, what helped here?

Working with members of this team, would you consider that your unique skills and talents were valued and utilized? If so, how?

What else would you like to tell us about this experience overall?

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Availability of data and material The datasets analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval This study received ethical approval from the RCSI Research Ethics Committee (ID: 202103004).

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