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An Investigation of Design Students' Remote Online Learning Experiences During the COVID-19 Pandemic

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ABSTRACT

Given the abrupt shift to fully online learning environments in our Department during the COVID-19 pandemic in March 2020, we needed to understand how to support students in their learning in this new normal. This paper is taken from a larger online survey study of 440 design (comprising architecture, landscape architecture, urban design and urban planning) students and focuses on the qualitative aspect to understand the benefits and challenges students faced in transitioning to online design studio learning environments. The main benefits found were time and cost savings, i.e. the convenience of not having to travel to school, and saving on transport and printing costs. The key challenges students faced were difficulty communicating and presenting their ideas during online learning, the loss of peer-to-peer learning that happens in a design studio space, and poor physical environment at home. In particular, it was perceived that online design learning could not emulate, to the same extent, face-to-face studio culture where students would receive spontaneous feedback from instructors, experience a collaborative environment and sharing of peers' works progressively. The paper concludes with some implications for moving forward, pointing to blended learning in the new normal.

INTRODUCTION

The COVID-19 pandemic has disrupted academic life worldwide and Singapore is no different. As infection cases increased, the government tightened safety measures and in mid-March 2020 (Week 8 of a 13-week semester), the National University of Singapore (NUS) Department of Architecture (DoA) had to adopt online teaching fully for the rest of the semester without much preparation time. It was a difficult time for faculty and students with the abrupt switch. In view of this, the Department conducted the Transition to Online Learning Student Survey to understand how to better support students and faculty for the following semester. This paper describes the rich qualitative findings from the survey, particularly the challenges and adaptions, from a design student's perspective, brought about by the abrupt transition to online learning.

About the NUS Department of Architecture's (DoA) Design module

Design is a core module offered every semester at the DoA to every level using small-group teaching approach. Each cohort has 100 to 120 students divided into studio groups of 8 to 12 students, led by an instructor (termed "design tutor") who is a full-time faculty or part-time staff who are architects. Studio groups meet with their tutors once a week for eight hours, except year ones who meet twice a week for 4-hour sessions. All classes of the same level are carried out concurrently in the same open-plan flexible studio space where there is space for making models, as well as presenting drawings and models during reviews. Students from different groups can see and interact with each other in the studio space. During non-class hours, they are given access to work in the studio as well. The studio environment encourages peer learning and exchange of knowledge, and plays an important role in their learning process. Projects at different levels vary from individual projects to group work. Our design pedagogy emphasised Making (i.e. iterative production of drawings and physical models), especially for the junior years.

During the pandemic circuit breaker (lockdown), the University was closed along with the studios, woodwork and laser workshops. Design modules were conducted online synchronously via Zoom as the main instructional mode. With this sudden shift to remote online learning for all design students, immediate concerns about instructional quality and learning experiences were raised. The two key questions identified and formed the basis of this paper were as follows:

- What are the challenges and benefits that design students face to transit from on-campus to online design studio learning?
- How do they adapt or overcome the challenges?

LITERATURE REVIEW

Architecture design pedagogy

Studio learning makes up the core of tertiary education for design students. Especially for architectural pedagogy, the design studio is deemed a rite of passage for students in becoming architectural professionals (Lewis, 2013; Iranmanesh & Onur, 2021). It is characterised by the socio-spatial construct where students are immersed in an environment that simultaneously enable creativity through active learning, encouraging interaction and social engagement (Wang, 2010). Unlike traditional university classes, where knowledge transfers happen in lecture format and students typically receive feedback after learning has been completed through summative assessment, design students' learning is shaped by continuous feedback and a cycle of action and reflection. Schon (1987) explains that a design studio is centred on 'learning-by-doing' and 'reflection-in-action': students are tasked with projects with the goal of learning through the experience of designing; students are also put in the guidance of tutors who are typically professional architects, to supervise and discuss project ideas with them in a reflective dialogue.

Studio projects are often open-ended problems to which there are no absolute solutions (Blair, 2006; Crowther, 2013; Fleishmann, 2019). Ideas are therefore discussed with design tutors and peers, facilitating a reciprocal dialogue that guide the students' learning process. A key aspect of this dialogue is carried out during the studio critique, commonly referred to as 'crit'. It is the central mode of assessment in architectural education (Blythman et al., 2007; Day, 2013; Fleischmann, 2016), whereby students present their work-in-progress to the instructors, peers and often design professionals to gain constructive feedback. Crit is intended to stimulate students' creative development and help foster the ability to reflect on the quality of their design and that of others.

Beyond the critique sessions, the design studio also facilitates informal background learning through peer interaction and collaboration. This social aspect of collaborative learning is often regarded as 'studio culture' (Wagner & Gansemer-Topf, 2005). According to Fleischmann (2019), studio culture entails the "active participation in a community, which afford the opportunity to engage in peer learning and experience the design studio as a social space" (p. 8). The design studio is shaped to create a tacit learning process that equips architectural students with communication and collaboration skills essential in the profession.

Transition to online learning

Across the architecture discipline, the discourse about online learning have been divided regarding its efficacy in keeping the positive qualities of a physical design studio whilst minimising the detrimental impact of an online setting. Conducting design studio online has shown great potential in establishing a better connected and interdisciplinary environment for learning (Webster, 2008; Wojtowicz, 1995; Sagun et al., 2001). Students also highlighted the improvement in conducting independent research (Iranmanesh & Onur, 2021). However, educators in design discipline have raised concerns that online communication methods may be insufficient for studio-based classes as the lack of physical space may not fully emulate the studio culture and background learning among students (George, 2017). These are generally viewed as something that requires a face-to-face environment (Schön, 1987; Webster, 2008). Thus, the social aspect of a physical design studio may be challenging to translate in an online format.

Prior to the COVID-19 outbreak, a handful of scholars have explored the capacity of blended learning curriculum for the architecture discipline. According to Bonk and Graham (2006), blended learning (BL) refers to the combination of face-to-face instruction with computer-mediated instruction through the adoption of learning management systems (e.g. Moodle, Blackboard etc.) and other online communication platforms (e.g. Zoom, Google+ etc.). Mohammed (2017) implemented a blended e-learning technique in his architecture design studios by using cloud technology such as Google drawings that allowed for both synchronous and asynchronous interactions virtually. Students in the experimental model highlighted that the blended learning enhanced their concept and idea generation in the early stages, improved their presentation skills, and raised the overall interactivity of groups. Other past literature suggest that the integration of off- and on- campus mode of design studio can benefit students' learning through self-determination, self-management, and personalisation of learning environment (Saghafi et al., 2012). Despite its promising benefits, however, blended learning for architectural studios have not been vastly adopted at the same scale as other higher education disciplines.

Online learning during outbreak

In 2020, architecture schools across the globe had little choice but to transition to online learning due to the pandemic and the resulting abrupt closure of campuses. Many scholars used this opportunity to assess their respective efforts in adapting design studios online amidst lockdown and social distancing measures. Ceylan et al. (2020) found that architecture students in Turkey enjoyed the ability to refer back to recorded discussions

with tutors and peers, but stated the need for better visualisation and representational methods in an online setting. Peimani and Kamalipour (2021) highlighted that the main areas of concern amongst students in their university at Wales, UK were the inability to effectively facilitate peer interaction and small group learning. On the other hand, students in Nigeria primarily faced infrastructure issues such as electricity and internet access (Allu-Kangkum, 2021). Given that the transition to online learning was abrupt, methods of conducting online design studio by different global institutions varied accordingly. Hence, there is a need to further study and understand how the transition to online learning is affecting our students, especially when design studio learning is no longer feasible.

METHODOLOGY

This paper is taken from a larger survey study investigating the implications of online learning on design students during the pandemic. An online anonymous and voluntary survey was conducted through our digital learning management platform amongst NUS DoA students. It was held from 27 May to 7 June 2020 after the semester ended but before student results were released, in order not to prejudice their answers. We reached out to the entire design student cohort at DoA who were required to adopt remote online learning (791 students); a total of 436 undergraduate and graduate students responded (55.1% response rate). After pre-cleaning of the dataset, 418 completed responses were used for analysis.

The survey comprised two parts: a quantitative part (Part A) and three open-ended questions (Part B). Part A aimed to assess the relationship between students' self-regulated learning strategies and their intention to use technology. On the other hand, Part B examined students' personal self-reported accounts of their transition to an online design studio. To address our research question, and with the focus of further understanding design students' perceived experiences in online learning, this paper therefore considers only the student responses from Part B.

The open-ended questions from Part B are as follows:

1. What are the challenges/benefits that you face to transit from on-campus to online design studio learning at home/dorm in relation to LEARNING EXPERIENCES?

2. What are the challenges/benefits that you face to transit from on-campus to online design studio learning at home/dorm in relation to PROJECT DEVELOPMENT?

3. What did you do to overcome your challenges?

For Part B, the response rate varies for each question as students can choose to fill in their responses or "skip" and leave them blank. Approximately 50% of respondents were enrolled in Bachelor of Arts in Architecture and 30% were enrolled in Master of Architecture. The rest were from other Masters' programmes in Urban Planning, Urban Design, Integrated Sustainable Design, and Landscape Architecture (Figure 1). There was a relatively balanced distribution of male and female student responses (Figure 2).
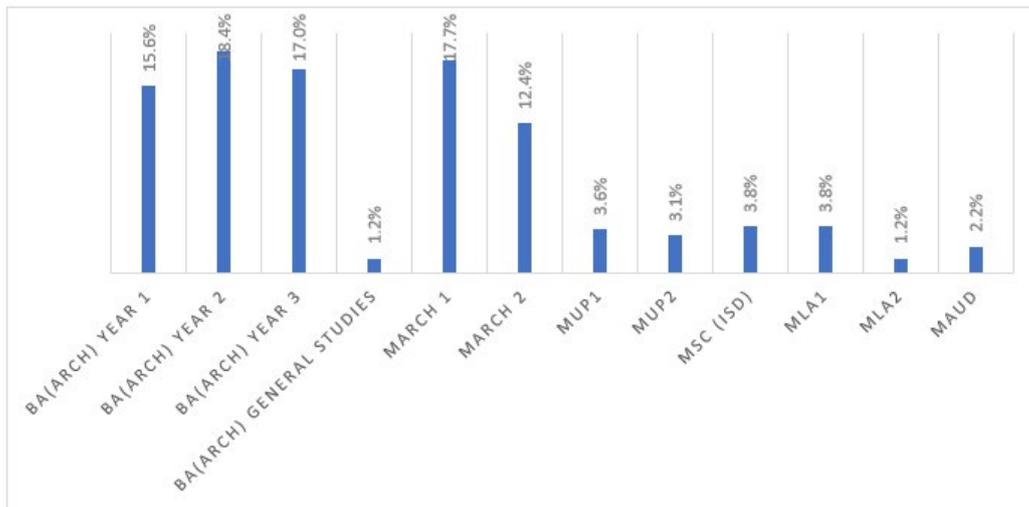
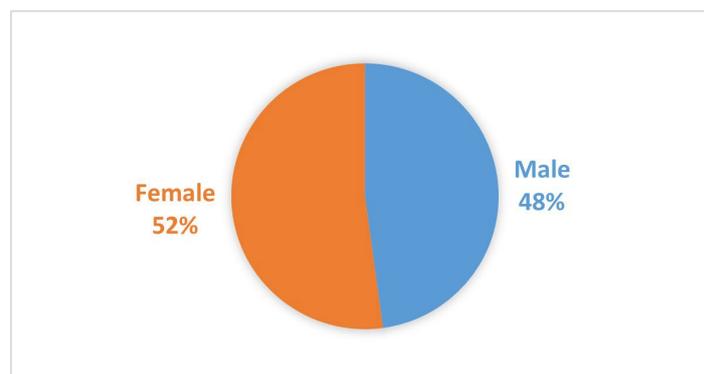*Figure 1.* Programme and Year Level of student respondents.

Figure 2. Gender distribution of student respondents.

Two raters carried out three rounds of iterative inductive text analysis and coding of the students' open-ended responses. The first round consisted of identifying common themes and developing a preliminary conceptual label to help create the coding scheme. The raters continued to refine the thematic framework in the second round of line-by-line coding.

After the first two rounds of individual analyses, the raters discussed and agreed on the final labels for the coding scheme. Eventually, after numerous rounds of textual analysis and discussion meetings, an inter-rater agreement of around 95% were achieved for coding each open-ended question.

FINDINGS

Challenges and benefits

Ten themes emerged when analysing student responses for the questions on the benefits and challenges of their transition from face-to-face design studio to online remote learning. Table 1 refers to the findings from Question 1 regarding students' learning experience, while Table 2 refers to the findings from Question 2 regarding students' project development.

Additionally, the tables are arranged in ranking order, with the top as the most recurring theme. Percentages in the brackets represent frequencies of responses for each theme. Each theme is further explained with sample

comments below. In general, design students faced greater challenges than benefits from online learning with regards to learning experience and project development.

Table 1
*Categories and frequency counts of students' responses to open-ended question on benefits and challenges faced transiting from on-campus to online studio with regards to **learning experience**. Themes in bold text are challenges and those without bold text are benefits.*

THEMES	TOTAL	RANKING
-Communication Challenges	133	1 (38%)
-Interaction Barriers	99	2 (28%)
-Convenience & Cost-saving	93	3 (26%)
-Poor Physical Environment	64	4 (18%)
-Learn with others	46	5 (13%)
-Learn by self	42	6 (12%)
-Negative Well-being	35	7 (10%)
-Coordination Challenge	29	8 (8%)
-Positive Well-being	10	9 (3%)
- Conducive Physical Environment	7	10 (2%)
Total (individuals)	353	

Table 2
*Categories and frequency counts of students' responses to open-ended question on benefits and challenges faced transiting from on-campus to online studio with regards to **project development**. Themes in bold text are challenges and those without bold text are benefits.*

THEMES	TOTAL	RANKING
-Communication Challenges	130	1 (43%)
-Poor Physical Environment	72	2 (24%)
-Interaction Barriers	57	3 (19%)
-Convenience & Cost-saving	40	4 (13%)
-Learn by self	33	5 (11%)
-Learn with others	27	6 (9%)
-Coordination Challenge	26	7 (9%)
-Negative Well-being	21	8 (7%)
- Conducive Physical Environment	7	9 (2%)
-Positive Well-being	3	10 (1%)
Total (individuals)	305	

Challenges

a. Communication challenges

Students faced difficulty communicating ideas to their tutors and peers during online learning. They also found it challenging to present their work and receive feedback through Zoom or other online platforms; while Zoom has an annotation function, not all tutors and students have adequate equipment to make full use of that function. 38% of student responses raised communication as a challenge for learning experience and 43% for project development.

> "I felt like communication was slower via online modes…ideas seemed to flow in a different manner when we were not able to sit next to each other and physically draw out or model out our ideas."

b. Interaction barriers

Students felt that online learning obstructed peer-to-peer learning and limited studio culture that would typically facilitate spontaneous feedback from tutors, a collaborative environment, greater exposure to peers' work, and more. This theme had the second and third highest frequency count pertaining to learning experience (28% of 353 responses) and project development (19% out of 305 responses) respectively.

> "Usually we would be able to walk around and gain inspiration or be exposed to more projects…Online studio only keeps exposure of other works within your studio, you do not get to see works from your own unit or others. You are isolated in that way."

c. Poor physical environment

Many students lacked adequate space, tools and equipment when working at home. The home environment, with family members also working from home, made it harder for them to focus. This theme had the fourth and second highest frequency count pertaining to learning experience (18% of 353 responses) and project development (24% out of 305 responses) respectively.

> "it is really hard to work without studio space. I am used to work with my hands, and home environment does not have enough space for me to work on models and there's a lot of distraction at home."

d. Negative well-being

Students' well-being suffered due to difficulties in adjusting to online learning, lack of separation between rest and work space, and anxiety from a lack of familiarity with software tools. 10% of student responses highlighted it as a challenge for learning experience and 7% for project development.

> "...[online studio] also made me less motivated to do things…the idea of meeting online does not provide motivation (usually dread and tiredness)."

e. Coordination challenge

Students found it harder to schedule consultations with tutors and project meetings with their peers. They also had difficulty coordinating the progress for group work and pace of work with one another. 8% of student responses highlighted coordination as a challenge for learning experience and 9% for project development.

> "It is difficult to coordinate work and ensure that everyone in the group follows the exact instructions which have been given."

Benefits
a. Convenience and cost-saving

Students saved on commuting time and transport costs while gaining flexibility in their schedules. They also saved on printing costs and costs of transporting the physical models. This was highlighted by 26% out of 353 responses pertaining to learning experience, but only 13% out of 305 responses for project development.

> "Online classes translate to cost savings as we don't need to print ridiculous deliverables on large paper sizes. It also makes my life as a student much easier, balancing time with other modules. I don't have to spend time making special trips to a print store."

b. Learn with others

Students felt that online learning enhanced tutor consultations (easier scheduling, more focused individual sessions) and facilitated easier access to and sharing of peers' work. This was highlighted by 13% out of 353 responses pertaining to learning experience and 9% out of 305 responses for project development.

> "...able to learn from studio mates' work while tutor gives feedback through screen sharing."

c. Learn by self

Students saw the transition to online learning as an opportunity to gain new skills such as software, time management, presentation and organisational skills. This was highlighted by 12% out of 353 responses pertaining to learning experience, and 11% out of 305 responses for project development.

> "Adaptation is something I learnt greatly from this transition. Finding new ways to explain ideas and solutions has brought new angles of research and understanding to my education."

d. Conducive physical environment

A few students enjoyed a more comfortable, spacious and less distracting environment at home for remote learning.

> "I have the necessary equipment, software and a suitable environment for learning, which is more comfortable than the studio, thus the online session actually worked in my favour."

e. Positive well-being

A handful of students felt less stress from remote learning and observed an improvement in their well-being.

> "Loved not having to travel to studio, less stress, and competitive feelings when I don't see the rest of the cohort. Much better mental health. Easier to control time management"

COPING STRATEGIES

Five themes emerged when analysing student responses for the question on how they overcame the challenges (Question 3). Each theme is explained below with sample comments. Table 3 is organised similarly to Tables 1 and 2.

Table 3

Categories and frequency counts of students' responses to open-ended question on methods of overcoming challenges.

THEMES	RANKING
- Adaption/ Self-Motivation	1 (32%)
-Communication	2 (26%)
-Peer Support	3 (23%)
-Planning	4 (20%)
-Self-Evaluation/ Help-Seeking	5 (17%)
Total (individuals)	291

a. Adaptation/Self-motivation

Students exhibited perseverance and adapted to the circumstances in order to overcome the challenges faced in remote learning (32% out of 291 responses).

> "Motivated myself to finish the project asap so that I can have more time to make corrections and changes if necessary."

b. Enhanced communication

Students invested more time and effort to effectively present their work and communicate their ideas. They also sought alternative communication methods such as email, WhatsApp, and more (26% out of 291 responses).

> "I took screenshots of design development process step-by-step to convey my idea and to show how I developed my design."

c. Peer support

Students proactively helped each other by collaborating and providing moral support (23% out of 291 responses).

> "I would still contact my classmates to have peer reviews of our progress and share insights."

d. Goal-setting/Planning

Students took the initiative to set goals, plan their schedules, and prioritise their work (20% out of 291 responses).

> "I had to make plans (what drawings to be included) in advance and discuss them with tutors. Furthermore, efficient time management is extremely crucial to ensure that effective developments can be produced."

e. Self-evaluation/Help-seeking

Students proactively sought assistance from tutors, and effectively evaluated their understanding during and after completing the consultations (17% out of 291 responses).

> "I prepared questions before the Zoom meetings and summarised the feedback gained after each tutorial session."

DISCUSSION

We summarised the findings into four critical areas for online design studio: the communication and interaction barriers found in remote learning; the loss of social environment of physical studio space for peer learning; the lack of a conducive physical environment; and the overall benefits perceived by the students. We also compared with existing literature to better understand its direct implications for teaching and learning in online design studio environments.

Communication and interaction barriers

It is unsurprising that communication and interaction barriers were identified as students' primary obstacles for design studio in an online setting. As highlighted in the literature review, the learning experience of a design studio requires an iterative process that adopts a dialogical approach and face-to-face feedback (Schon, 1987; Fleishmann, 2019; Ceylan et al., 2021). The findings support the argument that existing online communication methods may be insufficient for studio-based classes (George, 2017). From the student responses, communication challenges during project development arise from the inability to get productive feedback from peers and tutors, unlike physical studio sessions which have the benefit of on-the-spot physical sketching and manipulation of models. Even though Zoom has an annotation function, not all tutors and students have adequate equipment to fully utilise that function. Drawings and models are also hard to convey digitally because they lose their sense of scale, which might lead to the loss of finer details in intricate drawings. As a result, students indicated that this affected what they were able to produce for their final reviews, with some schemes conceptualised before the transition being negatively affected by the limitations of online reviews.

Loss of social environment of physical studio space for peer learning

Students perceived the absence of studio culture as a key downside to remote learning. It is very difficult to foster the studio culture of active participation in a community and rich peer learning experiences in an online environment (Fleishmann, 2019). This challenge resonates with the findings by Peimani and Kamalipour (2021) whereby architectural students from Wales, UK were concerned about the lack of peer-to-peer interaction and learning in an online setting. In our study, many students highlighted the difficulty of replicating the intangible quality of a physical studio. For example, students mentioned how they benefited from being exposed to other students' work as they casually walk around the studio. This is theoretically supported by Hutchins' (1995) "horizon of observation" model which argues that it is critical for students to be able to observe each other, especially advanced peers, in order to gain more advanced skills. Thus, there is a need to formulate methods of simulating authentic learning in an online setting.

In response to these challenges, students have adopted alternative communication methods and sought peer support in their transition to remote learning. Students resorted to video production, diagrammatic Gifs, animation, PowerPoint slides, amongst many others, in order to effectively present their work online. For example, a student mentioned taking step-by-step digital screenshots of their design process in order to accurately convey the development of their idea. Additionally, students also proactively reached out to their course mates to share insights and perform peer reviews. Some students even attempted to simulate the social environment of a physical studio by having passive video conference with other students as they individually work on their project.

Poor physical environment

Students have highlighted that the lack of a physical studio was a great challenge to their learning experience. Most students described their homes as being unconducive, without adequate space, tools, and equipment. This corresponds to the 10% of students who stated that their psychological and emotional well-being were compromised due to the isolated learning environment. Some students also mentioned feeling disadvantaged by not having access to necessary software and extended social circles for support that could typically be found in a physical studio space. Saghafi et al. (2012) emphasised that learning spaces is especially crucial for design students where the environment needs to be supportive of their expression and creativity. Physical studios provide the cultural identity, attractive physical attributes, and exhibited works which are publicly displayed. Traditional design studio facilitates learning through open discussion and hands-on activities (Sara, 2006). Thus, Fleishmann (2019) suggested that online learning was limited in design disciplines that focus on the creation of physical objects.

Moreover, students perceived the poor physical environment as a greater disadvantage for project development (24%) compared to learning experience (18%). Project development refers to the process of project ideation, revision, and working towards the final critique. Students typically require sufficient space for their model-making and drawings, in particular the year two students' project was making 1:1 prototypes. Hence, the lack of a physical studio impedes their hands-on iterative experience and exploration of scales which in turn affect the overall ideation process.

Perceived benefits

The main benefit students felt from online learning was the convenience of not having to travel to school, and spending less on materials for printing and model-making ("convenience and cost-saving"). Online learning allows students to learn remotely and enjoy a flexible schedule (Newman et al., 2018). The removal of geographical barriers also creates opportunities for international guest juries to be invited for crit sessions and give wider perspectives to the students' benefit (Ceylan et al, 2020). Additionally, some students also noted that their learning experience had improved in the form of more focused consultations, and a less stressful environment during online sessions ("learn with others").

Lastly, a few students saw the transition to remote learning as an opportunity for self-improvement in areas such as time management, software, presentation and organisational skills. For example, a student commented how the opportunity to find alternative ways to explain their ideas and solutions have provided them fresh perspectives of their research work. This group of students are relatively optimistic and took it upon themselves to make the most out of their circumstances. This finding mirrors that found by Iranmanesh and Onur (2021), whereby their study indicated an improvement in students' ability to conduct research and communicate digitally.

IMPLICATIONS

From the findings, students felt that online learning removed peer-to-peer learning that happens in a studio space, and also limits studio culture (e.g. spontaneous feedback from tutors, collaborative environments, sharing of peers' work progressively). Students faced difficulty communicating ideas to their tutors and peers during online learning. They found it challenging to present their design projects through video-conferencing platforms such as Zoom.

For effective learning in an online design studio environment, we can consider the following instructional design approaches:

a. Blending online and on-campus learning opportunities

Our findings corroborated with the literature, in that the social aspect of design studio is challenging to translate to an online format. Tutors should be cognisant of the pedagogical differences between online versus face-to-face classroom formats, and design the lesson plan to leverage on the strengths of online learning for certain tasks and balance with on-campus studio instruction and interaction. More studies on using blended learning in design studio context could shed light on the effectiveness of this learning approach.

b. Developing self-regulatory learning strategies

The ability to self-regulate in online environments is an important skill when students learn remotely, regardless of whether it is teacher-led or self-paced. Helping students develop self-regulatory and other useful learning strategies (especially in an online studio environment) would be a key priority for teachers to incorporate into their pedagogical approaches.

c. Fostering online interactivity and engagement

To mitigate the loss of interaction in a physical studio space, tutors should put in more effort to create opportunities for online interactivity and engagement. Platforms such as WhatsApp, posting students' progress on their studio Instagram were some attempts to keep students in touch with what is happening.

d. Integrating online tools for collaborative and peer learning

In the semester after this study, some tutors adopted Miro boards[1] to mimic the studio environment, and the response has been encouraging. Students were asked to post their weekly progress on a Miro board for all to see and also encouraged to post comments about their peer's works. More research is needed to develop online platforms that can emulate a face-to-face studio culture.

e. Re-think the type of group work assignment

With the challenge of communicating online for group work, tutors should consider carefully how to get students to work together in the online space. The usual requirement of constructing large physical models as a team is no longer feasible.

f. Continuous monitoring of student perception

The survey has informed us of how to plan the following semester during the pandemic and it will be a good practice, at the departmental level, to allocate resources to continue monitoring students' perceptions as we continue to engage them.

There are limitations of this study that must be considered when interpreting the results and findings. If we have had a higher response rate than 51.5%, it would have given us a better picture of the findings and outcome.

Moreover, if we have had more time and resources to conduct focus group discussions, we may have obtained a more in-depth understanding of the challenges and benefits.

CONCLUSION

In conclusion, the transition to remote learning appears to be more challenging for students enrolled in design studio. While remote learning offers immediate benefits to design students such as convenience and cost savings, students perceived that the communication and interaction barriers have hindered their learning experience. This is particularly the case for design studio which relies on an iterative process where student's learning is shaped by continuous feedback, cycle of action, and reflection. Therefore, there is a need to consider better online collaboration tools and digital peer-sharing platforms in an online design studio. The lack of an adequate and conducive physical space was perceived to be challenging as well, especially for the students' project development. Students missed the social aspect of physical design studio for peer learning. All these point to the need for a further exploration of a blended learning model consisting of both physical and online studio sessions.

ENDNOTE

1. Miro Board is an online software that provides synchronous collaborative whiteboard features to visualise ideas and work on projects individually or with a group.

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