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Blended Design Education: Experiences, Challenges and Opportunities

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Blended Design Education: Experiences, Challenges and Opportunities

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Abstract: The pandemic has had a noteworthy impact on education and design studios are no exception. While there have been challenges, these impacts have opened up new opportunities for innovation and creativity. Depending on this rationale; we scrutinise the experiences, challenges and expectations of design instructors within current blended learning practices in the design studio. We adopted a multiple case study methodology considering four first-year studios across four departments from two universities as individual cases. A thorough thematic analysis highlighted issues related to live telecommunication, student works, reflective practice, asynchronous work, and student participation and interaction. Results provide insights into how these issues are considered and handled by the instructors. By discussing the opportunities and challenges brought by blended learning practices, we aim to contribute to the existing knowledge by offering recommendations for future implementations of blended learning models in design studio education.

Keywords*: blended learning; studio pedagogy; design education; reflective practice*

Introduction

Blended learning is generally defined as learning that integrates both traditional learning environments and distance delivery, online delivery or asynchronous e-learning activities (Bonk & Reynolds, 1997; Osguthorpe & Graham, 2003; Singh, 2003). Actually, there is no single definition or a single formula that assures learning is blended. The term *blended learning* was first coined in the late 1990s, and it became more widely used in the 2000s as information and communication technologies improved and online learning became more prevalent. During the first quarter of the 2000s, studies on blended learning increased swiftly and various research studies have demonstrated that blended learning made important contributions to students and institutions by means of students' satisfaction (i.e. Leung & Lavigne, 2019; Lim & Morris, 2009; López-Pérez et al., 2011; Pektaş & Gürel, 2014).

During and immediately following the COVID-19 pandemic, blended learning gained significant popularity as an educational approach across all levels (Ahmad, Sosa & Musfy, 2020; Bernardo & Duarte, 2020; Fleischmann, 2020; Sugathan, 2021). Educational researchers have predicted that even after the pandemic subsides, the benefits of online

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instruction and learning will continue to be crucial, rendering blended learning essential for various fields and institutions. As Mete & Roy (2020) stated:

> The necessity of teaching and learning with asynchronous and synchronous platforms will yield significant benefits when these methods are layered into face-to-face instruction. After pandemic when the institutions will resume functioning, it will be felt that digital tools are complements, not substitutes, for the intimacy and immediacy of face-to-face learning. (p.201)

However, according to Peimani & Kamalipour (2022), there is still a significant area of investigation regarding its implementation and acceptance specifically within the realm of design studio education. According to Feng (2022), blended learning has brought a fresh perspective to higher education, leading to the emergence of new trends. The enduring implications of the pandemic-induced changes on higher education in the post-COVID-19 era are still uncertain. Therefore, it is critical to explore how education should be blended at all levels and in all fields, including the design field, for the future.

Not long before the pandemic, in 2017, Boelens, De Wever, and Voet conducted a systematic literature review in order to explore attempts to resolve the four key challenges of the design of blended learning environments, which are incorporating flexibility, stimulating interaction, facilitating students' learning processes, and fostering an affective learning climate. The findings suggest that blended learning design should focus on enhancing learner control, encouraging social interaction, and nurturing an emotionally positive learning environment. The research areas critical to achieving this goal include balancing learner autonomy and guiding their learning process, as well as balancing the increasing number of students in blended courses with the need for personalized learning experiences and a supportive, interactive climate.

Traditional design studio instruction emphasizes active participation and learning through hands-on experience. The pandemic prompted the exploration of online and blended learning, and its benefits continue to be integrated into studio education. To effectively leverage blended learning, it is important to examine its application in design studios before, during, and after the pandemic. Understanding the essence of these processes will inform future directions in design studio education.

Blended Learning in Design Studio

The design studio serves as the hub for teaching and learning, while studio culture plays a critical role in the student learning experience. This aligns with a socio-constructivist approach to learning, where students and instructors engage in co-constructing knowledge through tutorials and design reviews/critiques. Teaching primarily occurs through one-to-one tutorials or wall or table critiques, where instructors provide formative feedback on students' evolving design projects. However, when instructors transitioned to online learning during the COVID-19 pandemic, maintaining this dialogue-driven teaching approach became one of the most significant challenges. As classes had to be conducted online due to lockdown measures, design educators were faced with the challenge of figuring out the most effective way to maintain this dialogue-driven teaching approach through a digital medium. This challenge, which Fleischmann (2021) describes as a “sink or swim situation” (p.112), has resulted in a notable increase in research and publications focused on experience-sharing, providing us with more knowledge on the subject than ever before.

Metinal and Ayalp (2022) conducted a systematic literature review, bibliometric analysis, and content analysis to gain a thorough understanding of the effects of the pandemic on architectural design education and potential future projections. Their findings show that blended learning has opened up new educational opportunities and improved student outcomes. This is particularly evident through the use of hybrid approaches in studio courses that combine online technologies to enhance active engagement, synchronous critiques, and asynchronous learning. Additionally, they emphasized the importance of a balanced format that incorporates both virtual and physical teaching components. This applies to all design disciplines.

The majority of research studies focused on gathering feedback from both students and instructors (relatively more from students) regarding their online or blended learning experiences (Abegglen, Neuhaus, & Wilson, 2022; Datey, 2022; Grace et al., 2022; Peimani & Kamalipour, 2022; Sugathan, 2021). Some of these studies discuss the impact of the pandemic on studio education and how it has raised questions about the effectiveness of teaching design online. Traditional face-to-face studio teaching is viewed as providing knowledge and modelling professional attitudes, while online settings are seen as facilitating reflective and blended learning, peer interaction, and group collaboration (Datey, 2022; Dhawan, 2020; Fewella, 2023). Peimani and Kamalipour (2022) investigated the capacities and challenges of blended learning and teaching, with a primary focus on the experience and perception of students in the

context of design studio pedagogy. They emphasise that improving our understanding and assessment of students' learning experiences is a crucial aspect of developing and implementing blended learning and teaching frameworks that effectively combine the advantages of both face-to-face and technology-mediated approaches. It is vital to avoid solely prioritising a technologically deterministic mindset when shaping the future of higher education to enable richer and more meaningful learning and teaching experiences (p.9).

Furthermore, Sugathan (2021) investigated student learning in fully online classes and proposed a blended learning approach for better effectiveness. As the results show, students effectively apply cognitive skills to explore technology and achieve higher-order learning in fully online classes. Online discussions and debates help students express ideas and communicate effectively. Social media can enhance collaborative learning with the condition of monitoring ethical standards and data protection. Attending masterclasses led by industry professionals and international faculty encourages a holistic approach to design projects. However, the findings showed a lack of learning autonomy in fully online classes, which can be addressed through blended learning. Studio subjects require face-to-face interaction, while online mentoring supports concept development. Class recordings and electronic submissions facilitate revision and assessment. Sugathan concludes that blended learning combines online resources and in-person interactions for an optimized learning experience (pp. 10-11).

While there is no comprehensive study on the topic, the digital tools used in online education are one of the issues that current studies do not overlook. Although there may be slight variations in the tools employed in different design fields, it is apparent that they are largely similar. Video conferencing tools such as Zoom and MS Teams, learning management systems like Moodle, and remote collaboration tools like Miro and how different tools are integrated are often mentioned in the articles (e.g. Dhawan 2020; Fleischmann, 2020; Fleischmann, 2021; Stangel, 2021).

After an overview of related studies, it is evident that online design education has both benefits and drawbacks. Nevertheless, a consensus has been reached that a blended learning approach, particularly in a post-pandemic world, is a promising alternative to shape the future of design education (Peimani & Kamalipour, 2022; Fleischmann, 2021; Almandrawi & Ahmad, 2022). Hence, this study aims to explore the experiences, challenges, and expectations of design instructors in the design studio by expanding on the existing literature. Focusing on current blended learning practices, we seek to examine both the advantages and difficulties associated with this approach. Our purpose is to enhance the existing knowledge by providing recommendations for future implementations of blended learning models in design studio education.

Methodology

This research presents the initial findings of an ongoing research project investigating the potential of blended learning in studio education. The goal of the project is to develop a model for blended studio education by examining the experiences of design educators during the emergency distance education period in the early stages of the pandemic, as well as during the subsequent normalisation period. The gathered data encompasses teaching experiences from approximately five semesters, along with attitudes and expectations from the educators' point of view.

Table 1. Participants and data

Case	Institution	Department	Participants	Data
Studio A	Uni-1, Public	City and Regional Planning	2 instructors, 6 teaching assistants (8 participants)	Group interview recording (1h51m), video recording on a previous online class, video recording of a presentation outlining studio applications and student works during distance and mixed education
Studio B	Uni-2, Private	Architecture	4 instructors, 2 teaching assistants, 1 part-time instructor (7 participants)	Group interview recording (1h53m), notes from observations of hybrid studio application, websites hosting a virtual gallery of studio applications and student works during distance and mixed education, and collective student blogs
Studio C	Uni-2, Private	Interior Arch. and Environmental Design	1 instructor, 1 teaching assistant, 1 part-time instructor (3 participants)	Group interview recording (1h17m), notes from observations of online studio application, video records of distance and mixed period studio applications and interfaces
Studio D	Uni-1, Public	Industrial Design	2 instructors, 1 teaching assistant, (3 participants)	Group interview recording (1h43m), video records of distance and mixed period studio applications, students works and interfaces

We adopted multiple case study methodology by considering design studios as individual cases. Multiple case studies deepen our understanding of a phenomenon by examining how it occurs in different contexts (Stake, 2006). When collecting data in case studies, it is essential to utilise multiple sources that represent the case from various perspectives to ensure data triangulation (Yin, 2017). Therefore, we combined various sources to diversify data collection, as listed in Table 1.

Participants and Data

We investigated educational practices in first-year studios across four departments from two universities. All cases represent *basic design* studios of departments dealing with products, spaces and environments. Our focus was on the challenges of teaching and learning in a distance or blended context, given the three-dimensional nature and the newness of students to the field. Our data includes nearly seven hours of group interviews, studio practice observations, and archival materials such as project overviews, tools, and student works. We obtained approval from the research ethics boards of TED University (no. 589036) and Middle East Technical University (no. 28620816) prior to data collection.

Data Analysis

In order to ensure the reliability of the analysis, a triangulation approach was adopted (Flick, 2004). Accordingly, the shared experiences conveyed by multiple participants in group interviews, observations, and compiled documents were considered as complementary data. The analysis process was carried out with the participation of multiple researchers and included open coding, axial coding, and selective coding stages (Williams & Moser, 2019).

The qualitative data analysis began with an inductive approach. Initial themes emerged, leading to a deductive approach and the creation of a thematic structure. The video recording of the first case was independently open-coded by four researchers using MAXQDA. Researchers then discussed coding and established basic principles. Each researcher conducted open and axial coding of the first case, which was discussed in a team meeting to generate a coding tree. Using this framework, at least two researchers independently coded each of the four cases (axial coding). The coding tree was finalized in a third meeting, with necessary changes made. Two researchers not involved in coding participated in team discussions to avoid internal bias.

Findings

Except for the initial onset of the pandemic (2019-20 Spring), all four studios shifted to fully online instruction during the 2020-21 Fall and Spring semesters. In the 2021-22 Academic year, blended and hybrid approaches were adopted. During the data collection period (2021-22 Spring), Studio A, C, and D combined online and face-to-face hours, while Studio B implemented a hybrid model with a camera, projector, and video conference tools for real-time connection between remote and on-campus students. It is important to note that social distancing measures limited studio capacity, prompting the use of blended and hybrid models.

Our findings are derived from studio teams' reflections on online, blended, and hybrid experiences, along with their projections. We will address thematic topics including live telecommunication, student works, reflective practice, asynchronous work, student participation and interaction; particularly how they were considered, handled and discussed by the participants. We will provide quotations to exemplify the themes by using pseudonyms to maintain anonymity.

The convenience of live telecommunication

During the period of emergency distance education and the subsequent normalization, Zoom was the primary video conferencing tool used by each studio. Some found the lecture content to be more effective than face-to-face instruction, with the added benefit of live telecommunication enabling participation from external stakeholders. The studios leveraged this opportunity to connect with professionals from diverse backgrounds for lectures, workshops, and design juries. For instance, Studio A integrated numerous lectures presented by professionals worldwide, expanding its network beyond what was previously possible:

> [An instructor] utilised her own network to bring together different perspectives and insights from people around the world on broader topics such as climate and the environment, in addition to design-related matters. [...] For example, we gather face-to-face in the studio, but we share the screen via Zoom [to the projector screen]. We can still connect and listen to someone from the other side of the world. This is actually a benefit of the Zoom environment. Perhaps, if it weren't for the pandemic, we would not have gained this habit in the studio. (Studio A, Aynur)

Events, such as seminars, can be spontaneous and open to multiple studios if publicly announced. This flexibility is achieved by moving from one virtual room to another, without space or commute constraints. Engaging external stakeholders is facilitated through workshops and design juries, where professionals from diverse backgrounds introduce students to various design communication tools and techniques as well. The flexibility of planning and organizing events expanded the teams' stakeholder network:

> Getting contributions from external instructors, juries and presentations has become much easier now, without the need for people to come [from other cities]. Our pool has widened significantly. We were very limited before [with people in our own city]. We no longer deal with the logistics and accommodations of those who will come [from other cities]. I think this has been a great achievement. (Studio B, Burcu)

All participating studio teams mentioned having taken advantage of live telecommunication to invite external stakeholders. Many instructors emphasised this as an added value, and that they intend to continue integrating them into the studio in the future.

The quality, format and outreach of the design works

The pandemic's impact led to the early adoption of digital tools in the studios, shifting instructors' perspectives towards manual work as they saw the benefits and opportunities brought by digitalisation. This affected the quality and format of students' design works, as well as documentation practices. Lockdowns and mobility restrictions pushed the instructors to find creative ways for students to create models without proper materials. Instructors, facing freshmen with no experience in the following academic year (2020-21), had to incorporate digital design tools early on. Hybrid practices combining digital and physical environments were seen as opportunities for augmenting learning by “experimenting to see how [the design works] can be enriched with another [digital] tool” (Studio A, Damla), and “maximising the advantages” (Studio B, Deniz). Digital modelling is favoured for providing better control over form, which might be difficult to achieve via physical models by first-year students:

> Architecture students may avoid forms they can’t model physically. […] They can do digital modelling much more easily. We did not give up physical models though; it was mandatory for the assignment. […] They didn’t give up despite having difficulties. They could have let go of [the intended forms] in physical models, but they did continue in digital even though [the models] were crooked. I think this is a gain at the first-year level. (Studio B, Burcu)

During online education, manual skills were not given priority as they were difficult to acquire and refine outside the studio and couldn't be adequately appreciated through low-resolution cameras. Therefore, instructors favoured digital media. For instance, Studio C students achieved advanced representation skills using design communication software.

Even though students became exceptionally competent in digital representation and presentation, model making is still considered a vital activity and skill, as it is a medium for “learning-by-doing” and it “improves hand-eye-brain coordination” (Studio A, Damla). Therefore, physical modelling was given priority again in the hybrid/blended studio in an effort to balance the digital with physical, and 2-dimensional with 3-dimensional representations. Another reason for balancing physical and digital is the importance of acquiring a sense of scale, proportion and space, which is hard to achieve in digital/remote because “you can zoom in-and-out” and “there is no gravity in digital” (Studio B, Neva & Cemil). Until the students excel at the abstract perception of dimensions and spaces, model-making is considered essential.

Documenting physical models required extra effort, leading to an emphasis on proper photography for archive quality and feedback effectiveness (Studio A, C and D). Weblogs were used for documenting design progress, with training and templates provided for standardized model documentation (Studio A, B and D). This was important “to simulate rotating the model in your hand” to improve feedback (Studio D, Gizem).

Digitization allowed for a comprehensive digital archive with responsibility shared with students. Moodle-based learning management systems (LMS) were used for official submissions by all studios, while Studio C and D also utilized Google Classroom for simultaneous viewing and assessment. This streamlined process enhanced the accessibility and efficiency of evaluating student works (Figure 1).

Studio A, B, and D used weblogs to document student project progress. Studio A emphasized personal blogs for creating a personal portfolio, while Studio B maintained a collective blog for sharing project works and general design-related content between students (e.g. movies, articles, books). Studio D utilized blogs for tracking progress and ensuring coordination across teaching teams:

> We used the blog as a means for crits. It made it easier to see the whole process and the previous versions of the project. Even though we had separate sections, instructors were taking turns to give crits. […] I guess we did that because it was the final project so the students get feedback from all of us. […] The blogs made it convenient to see the progress over the weeks. (Studio D, Gizem)

Digitization and structured documentation facilitate sharing of student works with external stakeholders. Damla (Studio A) highlighted the popularity of works shared on blogs and social media among colleagues and students from other universities. Studio B used online GIF galleries to effectively present project progress during jury/exhibition combined events, showcasing multiple stages (Figure 2).

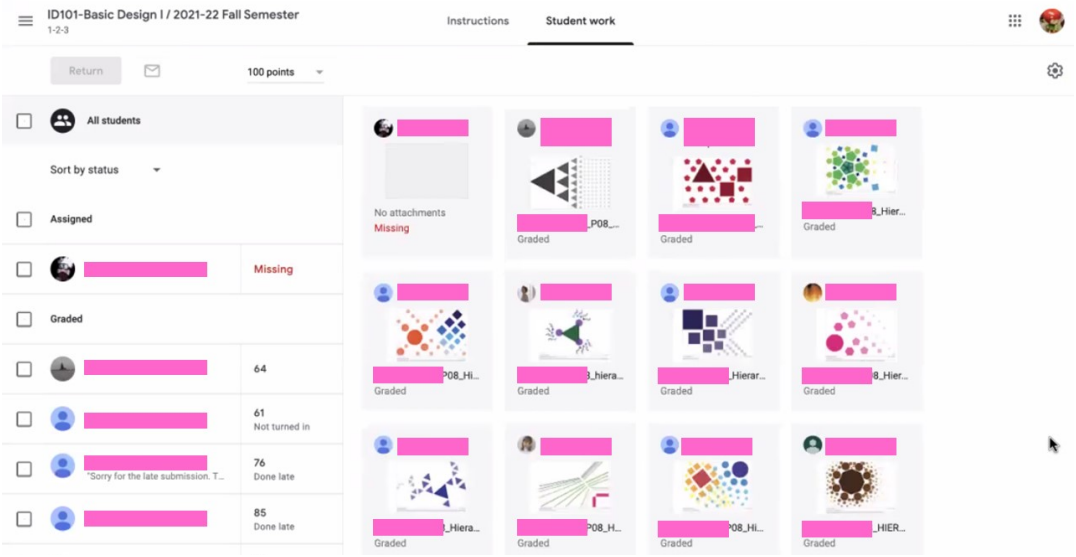

Figure 1. A submission page in Google Classroom assignment (Studio D)

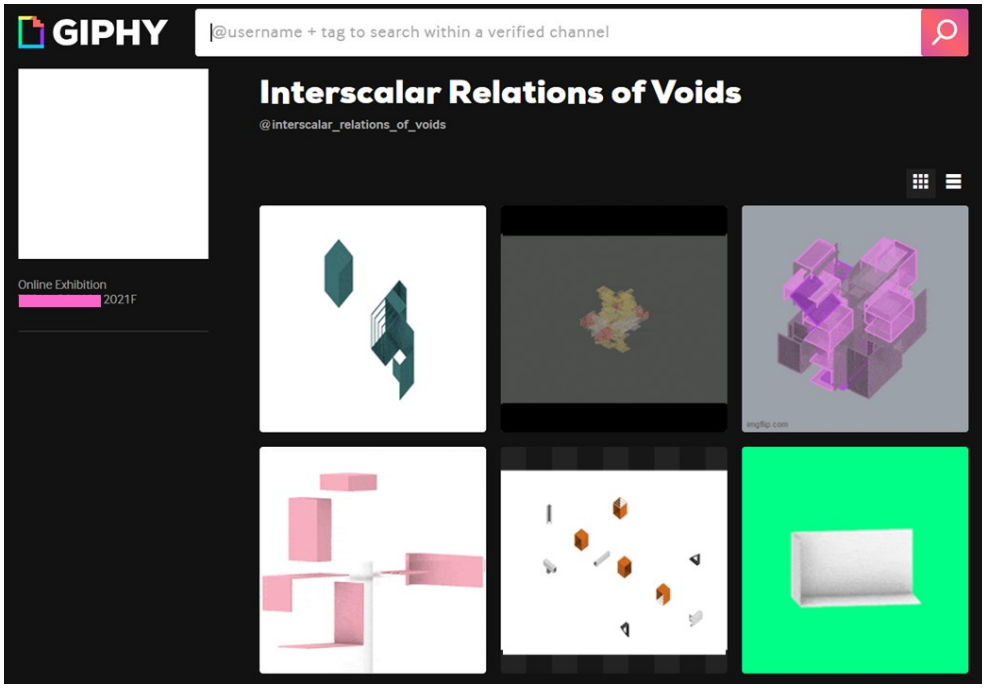

Figure 2. An online GIF gallery of student works (Studio B)

Addressing the obstacles to reflective practice and asynchronous work

Reflection on design works stands out in studio pedagogy. Schön (1984) views designing as a *reflective conversation* and the design process as *reflection-in-action*. Accordingly, students frame projects as design problems, engage in

reflective dialogues with instructors, and redefine the design problem. The core of reflection lies in the design critique, or *the crit*, a discipline-specific design language combining drawing and speech (Schön, 1984). However, the online environment disrupted these applied and conversational aspects. Instructors used various tools and methods to maintain or simulate reflective practice, such as Studio D's adoption of Miro, a cloud-based collaboration platform, and the use of Zoom's *annotation* feature for simultaneous talking and drawing (Figure 3).

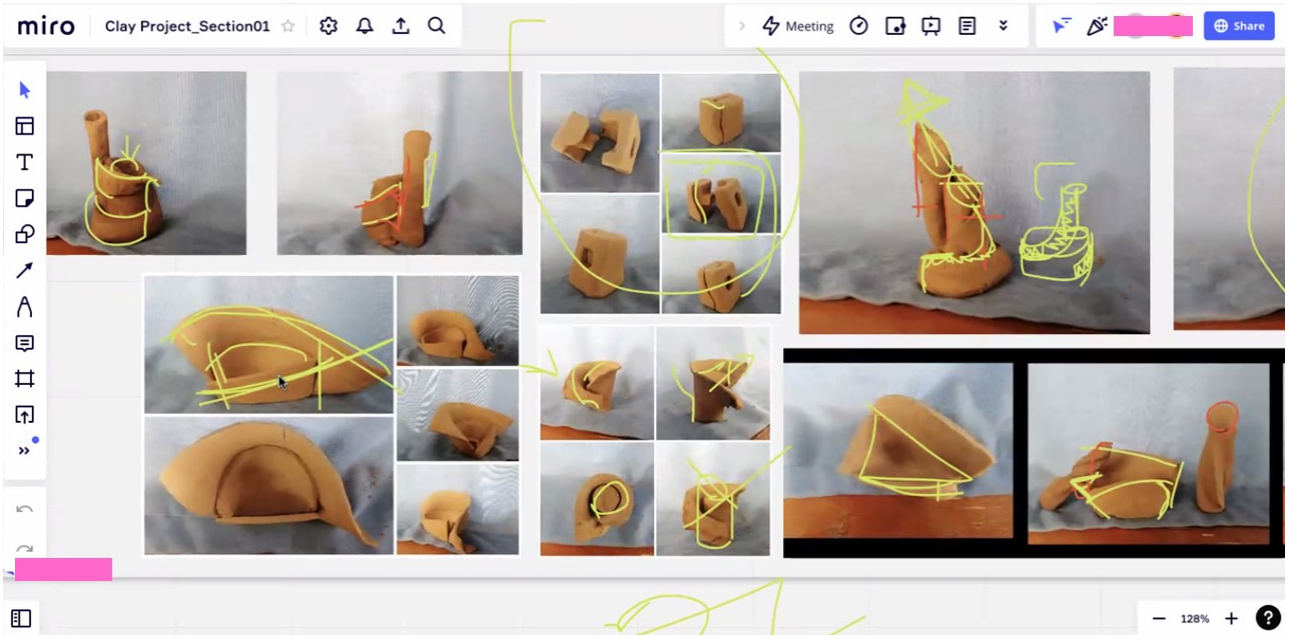

Figure 3. Design crits on a Miro board by combining drawing and speech (Studio D)

In the online studio, reviewing student works collectively and identifying shared issues can be challenging. To overcome this, Studio B instructors implemented a system where students upload their works to their blogs before the studio day. Instructors review the works in advance to identify issues for group discussions, following a format known as *panel critiques* that helps frame the projects. This approach saves studio time but increases the workload for the teaching team.

Meanwhile, instructors in Studio D had prior experience with an online learning management system (LMS) designed specifically for design education. The LMS included a feature for providing written feedback on studio works, although it was never adopted by the instructors before or after the pandemic. The studio team did experiment with asynchronous feedback using written comments but found it impractical. Another method employed was video recording the critiques as a monologue by the instructor, but it had its own limitations:

> For asynchronous crits, you need to spend twice as much time. If you don't rehearse before, you contradict yourself. When you are with the students, [they can ask] "But you said before...", [then you can reply] "I changed my mind, I guess this is better, what do you think?". [...] If it is not interactive, you shouldn't go through this thought process in front of them because it can be confusing. I can change my mind, I can try something else and find it better. This is also educational, in my opinion. It is a process. Look, I am trying. You should also be trying. [...] They see how to do [trial and error]. I am not transferring the knowledge that already exists in my head. It is valuable for them to see how I go through a process. [...] That's why it needs to be together. (Studio D, Defne)

Instructors highlighted the value of participating in critiques of peers' projects as a learning opportunity. Video conference critiques were considered effortless and equally accessible to all, unlike face-to-face critiques where physical proximity is limited (Studio C, Cemil). Studio B, which was conducting a form of hybrid studio at the moment, used a camera setup connected to a computer over Zoom, improving accessibility in their highly populated studio, as well as the inclusion of remote participants (Figure 4).

Figure 4. Setup of the hybrid design crit (Studio B)

Discussions revealed a divide between synchronous and asynchronous methods. While asynchronous methods have a role in blended learning, their application in design education has been rarely addressed. Instructors mentioned the advantages of asynchronous modes such as sharing resources for individual learning, but challenges arise from the lack of interaction and reflection, particularly in design critiques. Written feedback was deemed ineffective, and sharing recorded critiques lacked dialogical interaction. Even for lecture content, asynchronous delivery was found tricky due to its vague and abstract nature rather than conveying factual information:

> We discuss abstract topics like space, design, 3D perception, and visual language – things that are already hard to present for most instructors, things that you need to repeat. I attended a peer review of a professor in political science. She applied flipped classroom. It was so good because she talks about the transition to the multiple-party system in Turkey. It was neat and creative but it was nothing abstract. The students can Google the questions to find the answers. It is not like what we do. I did check the possibility of asynchronous methods but I find it impractical and unfair for first-year students because it can be quite subjective. (Studio A, Damla)

Asynchronous mode proved useful for sharing supporting resources and reference materials, such as design software tutorials, theoretical sources, and articles from professional magazines. Unlike other fields, the studio lacks a textbook, necessitating custom content creation. For instance, Studio A produced demonstration videos for terrain modelling and concept sketching. Studio C instructors curated Pinterest boards as galleries of existing works for learning and inspiration (Figure 5). These approaches saved studio time and enhanced project communication, highlighting the need for tailored resources in the studio setting.

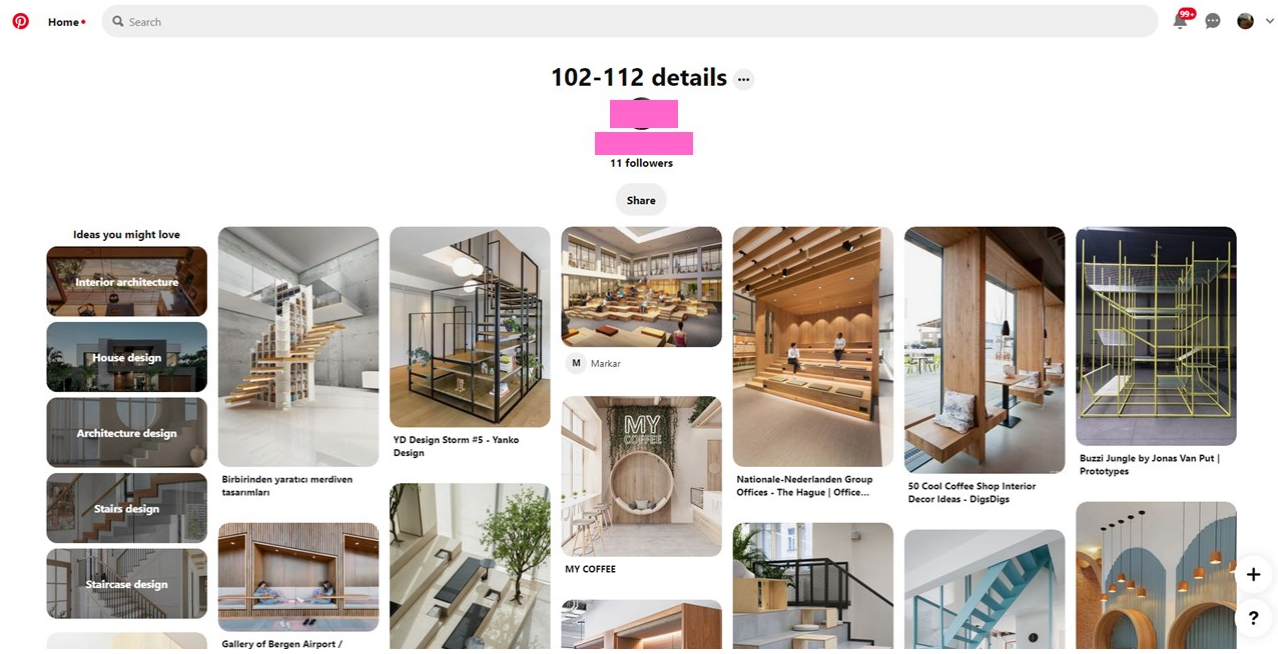

Figure 5. Pinterest boards created for the specific project requirements (Studio C)

Maintaining participation and interaction

Design studios, known for their interactive nature, faced significant challenges during the pandemic, as noted in the literature (Hananto, 2020; Milovanović et al., 2020). All participating studios in this study reflected on the impact of online, blended or hybrid models on participation and interaction.

Peer learning suffered particularly in remote settings, where students worked in isolated environments and submitted their work only visible to instructors through an online learning management system (LMS). To address this, Studio A implemented a collective blog where students shared their work and engaged in informal exchanges, fostering a sense of community. Additionally, they maintained a *buddy system*, pairing students to encourage collaboration, note-taking during critiques and juries, and providing feedback and support for each other's projects. This system precedes the pandemic and during online education, they encouraged students to go to the project field visits as buddies.

The 2021-22 academic year marked a transitional period, with limited face-to-face interaction due to social distancing measures. Strategies were implemented to reduce the number of students gathered at the studio, such as blending online and face-to-face hours. However, many instructors observed that this approach negatively impacted student participation and motivation (Studio A, C & D), leading to confusion and a false perception that only face-to-face hours were significant. To address this, Defne (Studio D) suggested flexibility in switching between online and offline modes based on project activities rather than fixed hours.

Regarding online-offline preferences, instructors held contrasting views. Cemil (Studio C) believed online critiques to be more efficient, as Zoom allowed for easier participation and engagement than a physical table. His colleague highlighted that critique sessions with smaller groups in *breakout rooms* enable more active student involvement:

> We split into groups of approximately ten [students]. This way they feel more special and they ask more questions. When all forty of us are gathered [in Zoom] for the crits, they shy away from asking what they have in mind. (Studio C, Ömür)

Damla (Studio A) noted the dominance of a few students in online courses, prompting the integration of various tools like Slido and creating collective word clouds to encourage participation without speaking. This approach catered to different communication preferences. Instructors from Studio B observed seemingly quiet students becoming more active in forum discussions. They also mentioned utilising the chat box in Zoom to casually ask questions, e.g. “Is this a surface or plane?”, to monitor the actual presence, and assess how well the discussed concept is comprehended. However, despite efforts, many instructors found the online mode ineffective, reducing students to passive recipients:

> Students expect ready-made content delivery [rather than] hands-on effort. I observe a few students coming to the fore with active participation – verbally and performatively, while the rest are passive listeners. They experience the "open" version of architectural education. They work after class hours, yes. But it is much different than the education I've known. (Studio B, Galip)

Another concept raised was the lack of *spontaneity* in the online studio. For example, live teleconference creates a stage-like environment which makes informal and spontaneous interaction difficult, making communication rather "serious" (Cemil, Case C). Being "under the spotlight like live TV" is bothersome for instructors, too – this is not the case in the physical studio because the spotlight is distributed in the space (Deniz, Studio A). This makes informal communication and natural turn-taking much easier:

> In the online studio, the only place to reach me privately is the chat box. […] There is only one stage to talk on. But there is not a single stage in the [physical] studio. They can approach me and show me their work while formal crits are going on. […] They can pull me over and ask questions. They have to do it in front of everyone in online classes; maybe that's why they don't. I get more questions face-to-face. (Studio D, Demet)

Another aspect of spontaneity is the ability to observe students in real-time working in the studio and intervene. This is found valuable as it gives room for reflection-in-action and guides students towards the learning outcomes. This is easier face-to-face, otherwise, it is too late when noticed (Studio B, Deniz).

The formation of *studio culture* is another challenge of online education. Although the participants do not propose a static definition of what constitutes the said culture, the lack of it can be observed from ways of communication, interaction and making. Studio B team complained about being called "teacher" or "sir" by the students due to the lack of natural interaction normally experienced in the studio. Others complained about how the notion of an iterative design process cannot be established. Rather than spending the studio time to work on their projects, get feedback and improve, Studio D instructors observed students tend to get critiques and leave. This is perhaps caused by the online studio routine, which prioritises the discussion and diminishes the time for *making*.

DISCUSSIONS AND CONCLUSIONS

While there is a general consensus on the benefits of blended learning in design education, there are also conflicting points in the literature. Some studies question the effectiveness of teaching design online and emphasize the value of face-to-face studio teaching for knowledge acquisition and professional attitudes (Datey, 2022; Fewella, 2023). However, other studies argue that online settings can facilitate reflective learning, peer interaction, and group collaboration (Datey, 2022; Dhawan, 2020). Our findings provide insights into how the studios navigated this challenge by implementing blended and hybrid approaches that combined online and face-to-face instruction.

The pandemic has accelerated the adoption of blended learning, and it has opened up new opportunities for innovation and creativity in design studio education. The benefits of blended learning include improved student outcomes and enhanced active engagement through the use of online technologies (Metinal & Ayalp, 2022). Our findings support this by demonstrating how the studios incorporated live telecommunication and digital tools to enhance instruction and student engagement. The use of live telecommunication platforms allowed the studios to connect with professionals from around the world and invite them for lectures, workshops, and design juries, expanding students' networks and providing valuable insights and perspectives. Live telecommunication facilitated by blended learning allows real-time interaction and collaboration.

The pandemic necessitated the early adoption of digital design tools, which led to a shift in instructors' perspectives on manual work (Fleischmann, 2021). Our findings demonstrate that integrating digital tools early on resulted in improved representation and presentation skills. However, the instructors still acknowledge the importance of physical modelling for learning-by-doing and acquiring a sense of scale and proportion. The importance of balancing, or blending, physical and digital components in design education comes to the fore (Peimani & Kamalipour, 2022). The results of our study highlight that relying exclusively on online tools is insufficient at times, but when both physical and digital environments are combined, numerous benefits arise.

Our findings present the experiences and reflections of studio course teams on online, blended, and hybrid learning in design studios. Participants mentioned various benefits and challenges regarding live telecommunication, student works, reflective practice, asynchronous work, and student participation and interaction. We summarise our insights in Figure 6 to offer suggestions for effective learning in the blended design studio.

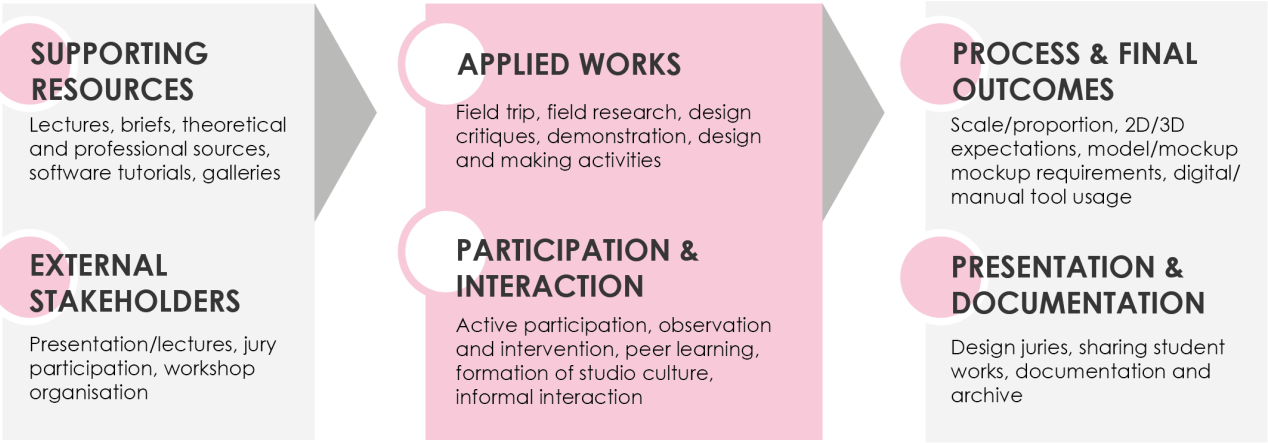

Figure 6. Summary of insights

Learning can be enriched with online and asynchronous resources as reference materials that students can review and access when needed, saving valuable studio time. Additionally, the flexibility of online communication platforms allows for the involvement of external stakeholders, such as experts and project partners, who can contribute their specialized knowledge and expertise remotely. The benefits of information and communication technologies were one of the leading aspects of the experiments with virtual design studio settings (Broadfoot & Bennett, 2003; Ioannou, 2018), and pre-pandemic blended studio experiences alike (Bohemia & Ghassan, 2012; Chen & You, 2010; Polaine & Bennett, 2010; Taşlı Pektaş, 2012).

However, when it comes to applied work, both asynchronous and online components present limitations that cannot be overlooked. These limitations arise from the dialogic and open-ended nature of design activities, particularly evident during design critiques. Educators argue that traditional methods and in-person environments should not be entirely abandoned. While online and asynchronous modes can complement and enrich the learning experience or serve as alternatives when necessary, they cannot fully replace the in-person studio experience.

Participation and interaction in online environments differ from the studio setting, as they tend to be more asymmetrical and less conducive to informal exchanges. These limitations can be attributed to the interface features provided by commonly used online platforms accessible to educational institutions. Furthermore, the bias of the instructors towards synchronous modes of interaction reinforces this notion. While it is essential to establish a structure that fosters the open and spontaneous interactions found in the studio setting, it cannot be claimed that online platforms can entirely replicate the unique aspects of a traditional studio environment. Collaborative work, process-oriented learning, and peer learning are vital components of design education that often require an on-campus presence.

The COVID-19 pandemic forced an early embrace of digitalisation, which is widely appreciated for its advantages. However, it is crucial to recognize the continued significance of manual skills and physical design tools. While digital design tools significantly enrich spatial design processes, they are problematic when it comes to maintaining scales and proportions. Physical models, on the other hand, continue to play a crucial role in product-scale design and communication. Digital tools and environments contribute significantly to process documentation and facilitate monitoring by instructors. The balance between manual and digital, as well as 2D and 3D representations, depends on the field, project, and educational level. For instance, physical ergonomics can only be discussed through tangible models, but digital presentation techniques offer opportunities for spatial perception and experiential understanding in cases where one-to-one interaction with physical spaces is not possible. During periods when face-to-face education is impossible or limited, the responsibility for documentation falls upon students. The development of students' skills in documentation is a valuable outcome of the digitalisation process. Digitalisation also brings about systematic archiving, enhancing the accessibility and shareability of works.

While existing literature often prioritizes student and instructor evaluations based on specific studios or projects or focuses solely on digital tools, our approach takes a more holistic perspective, taking the inherent needs of studio pedagogy at the centre of the investigation. Instead of aiming for a generalized model, we conducted a multi-case analysis based on real studio experiences to provide a forward-looking projection. Our findings and recommendations identify opportunity areas, discuss challenges, and propose strategies to overcome them. We believe our recommendations can also inspire educators to enrich face-to-face education. Further research could address issues

like the effectiveness of various blended learning models, assessment of the impact of blended learning on student outcomes and experiences, and facilitation of collaborative learning, peer interaction and learner autonomy.

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