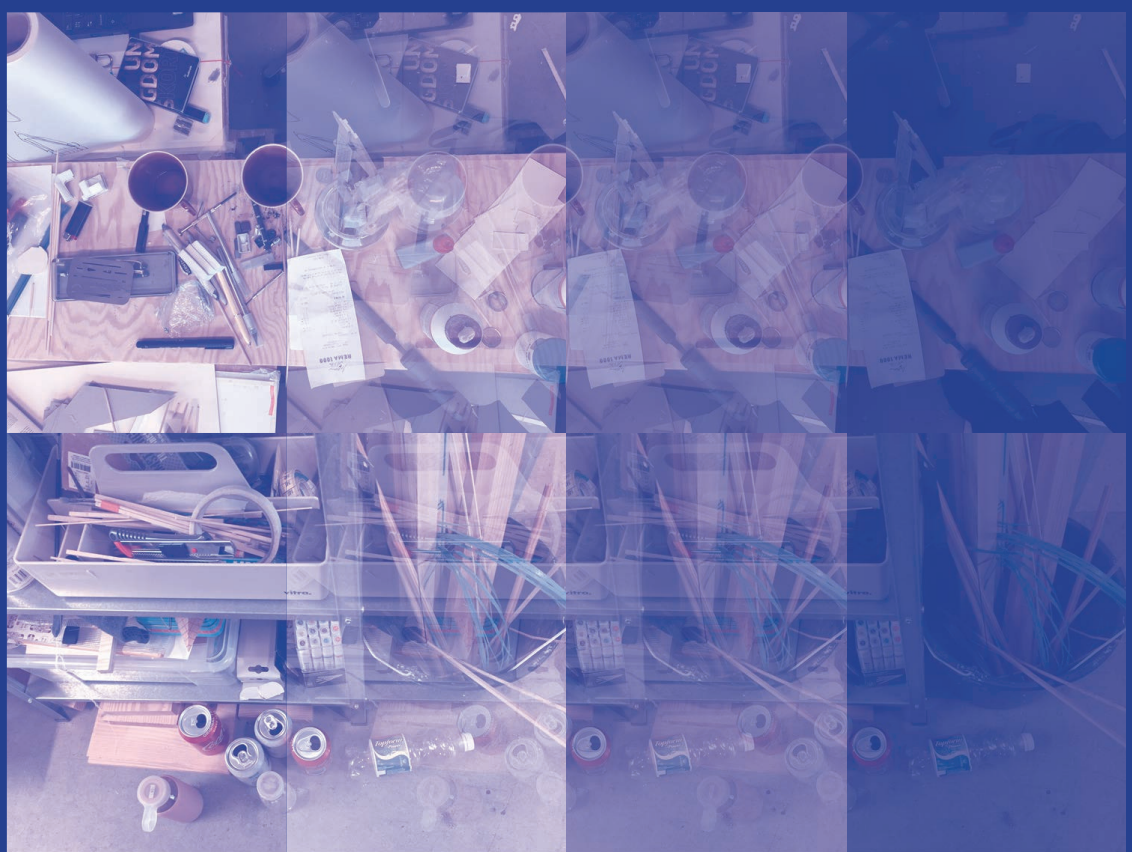
Sofie Pelsmakers, Elizabeth Donovan, Jenni Poutanen, Aidan Hoggard, Niclas Sandström and Kayla Friedman



Architecture Design Studio in Uncertain Times:

Digital Teaching and Learning Implications

Introduction

At the core of architectural education is the design studio [1], at once a physical learning and a community space, as well as a pedagogical construct. Here, an architectural dialogue and culture are established through peer-to-peer learning and social scaffolding within a community of practice.[2] Before the COVID-19 pandemic, most architectural teaching and learning took place face-to-face, between tutors and students, in the design studio. During tutorials, within the (semi)public setting of a studio, students would regularly 'pin up' their design work for face-to-face feedback on design development from tutors, guests and peers.

Especially in undergraduate courses, when students are starting their design education, tutors often actively demonstrate architectural design-thinking and 'reflection in action',[3] by improvisational drawing with the student. Reflection in action is the conscious ability to reflect on what one is doing while doing it. This master-apprentice hierarchical model was a predominant method of education and reflected Schön's critical reflection theory developed in the 1980s. Since then, many architectural education models have diverged from it.

In recent times, for many reasons, there has already been a noticeable reduction in both physical spaces and hours of design studio teaching with an increase in digital education.[4] The COVID-19 pandemic exacerbated this shift. Throughout much of 2020, the pandemic restricted the use of university buildings, challenging our modes of architectural design education and forcing us to rethink how we do things, both as students and teachers.

In a drastic shift, architectural design courses moved completely online. Several universities resorted to digital teaching for the entire pandemic period, with rare exceptions of face-to-face contact. This was the case in Finland, despite lower infection rates. In some countries (e.g. the UK and Denmark), individual tutorials and small group meetings could still take place face-to-face on campus with appropriate safety measures. However, due to stringent restrictions during peak infection rates, buildings were closed for several weeks or months. In these periods, when teaching and learning no longer took place in the physical space of the design studio, educators created new virtual design studios. The virtual design studio is a term coined more than twenty years ago when technology enabled us to work with others in virtual environments instead of being present in the same physical space. [5]

1. Donald Bates, et al, *Studio Futures, Changing Trajectories in Architectural Education* (Melbourne, 2015), p. 4.

2. Patience L. O. Lueth, *The Architectural Design Studio as a Learning Environment: a Qualitative Exploration of Architecture Design Student Learning Experiences in Design Studios from 1st-4th year* (USA, Iowa State University, 2008); Etienne Wenger, 'Communities of Practice and Social Learning Systems: the Career of a Concept', *Social Learning Systems and Communities of Practice.* ed. by Chris Blackmore (London: Springer, 2010), pp. 179-198.

3. Donald A. Schön, *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions* (San Francisco, USA: Jossey-Bass, 1987).

4. Including increases in student numbers leading to insufficient available studio space, pressures to reduce demands on space, and shifts to more hot desking.

5. Mary Lou Maher, Simeon J. Simoff, and Anna Cicognani, *Understanding Virtual Design Studios* (London: Springer-Verlag, 2000) and Thomas Kvan, 'The Pedagogy of Virtual Design Studios', *Automation in Construction*, CAADRIA, 10.3 (2001), 345–53.

This article questions if and how a virtual design studio can replace the traditional architectural design studio as a physical, cultural and pedagogical community space. It critically explores how far the virtual environment can uphold a design studio culture based on peer-to-peer learning and face-to-face teaching.

Background

This article presents perspectives from three architectural design courses in Denmark (Case 1, Arkitektskolen Aarhus, AAA), Finland (Case 2, Tampere School of Architecture, TSoA) and the UK (Case 3, Sheffield School of Architecture, SSoA) and an interdisciplinary design course (Case 4, University of Cambridge Institute for Sustainable Leadership, CISL).

In Case 1, the AAA Danish architecture school is structured around the traditional beaux-arts design studio model, where teaching happens face-to-face in a design studio space. Contrasting to this, and due to physical space constraints, in Case 2 (TSoA), the school is structured around an external design studio model, where most students design outside the studio space (e.g. at home) and meet tutors face-to-face on campus by appointment. In Cases 3 and 4, both in the UK, blended learning design studio models are employed.

These four specific cases, representing different design studio environments spanning different levels of architectural education (elaborated in each section), were all affected by the COVID-19 pandemic and thereby facing a sudden demand to shift to virtual design studios. Collectively, their diverse design studio adjustments provide insights about adapting virtual design studios across educational contexts for the future.

6.
David Boud, Ruth Cohen and Jane Sampson, *Peer Learning in Higher Education: Learning from and with Each Other* (Routledge, 2001), pp. 1-12

Case 1.

Aarhus School of Architecture (AAA), Bachelor design studio in the Radical Sustainable Architecture teaching programme, Denmark

Aarhus School of Architecture, hereafter AAA, is one of the two architecture schools in Denmark and has around 700 students, with approximately 120 students from the second to fifth years taking the Radical Sustainable Architecture route. Both second and third year undergraduate students are taught together in the design studio wherein students focus on one project for the entire 20-week semester, accounting for 100% of the grade. The design studio follows a traditional beaux-arts design studio model where the design studio is the primary platform for teaching and learning, and students are expected to be present in the dedicated studio space for five full days each week. A common brief is given to the students, who then individually focus on one open-ended, project-based problem with a design outcome for the entire semester. Individual work is supplemented by peer learning frameworks, collaborative tasks and smaller periods of group work.

Case 2.

Tampere School of Architecture (TSoA), Sustainable Architecture Master's degree, Finland

In Tampere School of Architecture (TSoA), one of three architecture schools in Finland, face-to-face tutoring takes place outside the studio space and represents the external design studio model. The school is relatively small, with a yearly intake of 45-50 students. Nonetheless, apart from the first two years, there is no dedicated desk space at the university. Instead, the design courses are based on formally scheduled events, such as weekly topical lectures and workshops supporting problem-based learning, bringing students physically to the same space.[6] Design projects are supported by peer-to-peer workshops during which the teacher facilitates groups of 10 to 14 students who review and comment on each other's work.

7.
Yasemin Afacan, 'Blended Learning for Non-studio Courses: Interior Architecture Student Experiences', *Procedia – Social and Behavioral Sciences,* 116 (2014), 1599-1603 and Bayram Güzer and Hamit Caner, 'The Past, Present and Future of Blended Learning: An in Depth Analysis of Literature', *Procedia – Social and Behavioral Sciences,* 116 (2014), 4596-460.

Case 3.

Sheffield School of Architecture (SSoA), Collaborative Practice 4th year Masters course, UK

There are around 700 architecture students at Sheffield School of Architecture, with 15 fourth-year students enrolled on the Collaborative Practice (CP) programme. Instead of the typical two years of full-time study within university, following at least a year of professional practice, Collaborative Practice students are employed in architectural practice and combine academic studies with practice in the blended learning design studio model. The course is centred around shared responsibility and collaborative action; students take responsibility for their learning and collaboratively shape it with their tutors.[7]

Case 4.

Cambridge University, Interdisciplinary Design for the Built Environment (IDBE) Master's (MSt), UK

MSt in Interdisciplinary Design for the Built Environment is a 2-year part-time course that attracts around 30 mid-career professionals per year from across built environment disciplines who learn how to work together to deliver more sustainable and resilient development. It is a blended learning design studio model: students undertake remote distance learning methods across six residential intensive learning weeks, five of which include face-to-face design studio. The studio is aligned to the thematic focus of the week, allowing students to apply learning to a studio project undertaken in interdisciplinary teams of 5-8 students.

In summary, at the heart of the four cases presented in this article is the design studio. This article is based on a literature review of different design studio models and architectural pedagogy, including the virtual design studio model. Reflection on the shift towards virtual design studios and its challenges and benefits is based on discussions and reflection throughout the pandemic, both within the institutions, among the authors, and during formal and informal student feedback and discussion. The first section of this article presents a brief literature review of different pedagogies, relating them to the four cases. The second section then reflects on the experiences of those four cases as they shifted to virtual design studios.

Architecture studio pedagogy

An architectural design studio is typically based on a shared physical, pedagogical and cultural community space.[8] Students develop their design, communication, negotiation and collaborative skills. They also develop critical thinking as they question competencies in a mutual and co-regulated learning approach with peers and teachers.[9] Foundationally, this template for the design studio goes back to Plato's humanistic discussion fora.[10] Later, in the 18th century in France, this model of learning led to full-time architectural education based on discussions with teachers in the mornings and more formal architectural science lectures in the afternoon.[11] This evolved into a teaching model at the Ecole des Beaux-Arts that consisted of part-time study of architecture subjects and part-time apprenticeship in an architecture studio.[12] From the early 20th century, there was a departure from this apprenticeship model towards a focus on problem-based learning.[13] There emerged the Bauhaus model of full-time study in a design studio space within the university.[14] This model advocated for design studios that reflected architectural practice. It sought to support the design studio with other subjects, combining arts with technology.[15] Despite increased attention to sustainability and sociocultural factors in the contemporary design studio, these core pedagogies remain central to many architectural schools and have not changed significantly in structure in recent decades.[16]

The physical space is fundamental in the design studio's role both as a learning and social space.[17] As illustrated by Case 1, the Aarhus School of Architecture, students spend all of their days, and often evenings, within the studio. Individual work, (in) formal discussion and even lectures commonly take place in this space. In contrast to the typical classroom, the design studio simultaneously houses multiple settings: individual working tables, a meeting area with a whiteboard or pinboards, and space to store or display design materials, models, books, drawings, sketchbooks and photographs. Moreover, every student has their own generous space and desk and may bring fridges, microwaves or sofas (see Figure 1). As a result, a close bond is formed within the group, fostering a feeling of trust and comradery.

Intense studio environments can, however, lead to high levels of anxiety and vulnerability, exacerbated by peer competition, a long-hours culture, and regular

8. Lueth, *The Architectural Design Studio.*

9. Allyson Hadwin, Sanna Järvelä and Mariel Miller, 'Self-regulation, Co-regulation, and Shared Regulation in Collaborative Learning Environments', *Educational psychology handbook series. Handbook of self-regulation of learning and performance*, (2018), 83–106 and Boud, Cohen, and Sampson, pp. 1-12.

10. Lance Green and Elivio Bonollo, 'Studio-Based Teaching: History and Advantages in the Teaching of Design', *World Transactions on Engineering and Technology Education,* 2.2 (2003), 269-272.

11. ibid.

12. ibid.

13. Marta Masdéu Bernat and Josep Fuses, 'Reconceptualizing the Design Studio in Architectural Education: Distance Learning and Blended Learning as Transformation Factors', *Archnet-IJAR: International Journal of Architectural Research,* 11.2 (2017), 6–23.

14. ibid.

15. ibid.

16. David Nicol and Simon Pilling, *Changing Architectural Education: Towards a New Professionalism* (London ; New York: Taylor & Francis, 2000); Green and Bonollo.

17. Valeria Borsotti and Emile Møllenbach, 'Classroom Habit(us) and Physical Co-presence in a Blended Learning Environment', *ICST Transactions on Ambient Systems* 3,9 (2016).

scrutiny of one's work by teachers, peers and others.[18] Especially in the earlier years of study, students learn to design by undertaking the actual experience of designing, i.e. they are having to do something that they cannot fully understand, until they have done it.[19] Even more, in both informal discussions and formal learning activities, students are confronted by often conflicting perspectives (cognitive conflict)[20] and conflicting emotive reactions (emotional conflict), which they must learn to critically reflect on and subsequently self-regulate and self-prioritise. These issues can be minimised by 'buddy systems' as employed in Case 1, where a 'buddy' is a 'critical friend' and a support person with no power asymmetries that define the relationship.[21]

18. Lueth, *The Architectural Design Studio.*

19. Schön, p. 80.

20. Jean Piaget, The Equilibration of Cognitive Structures: the Central Problem of Intellectual Development (Chicago: University of Chicago Press, 1985).

21. Arthur Costa and Bena Kallick, 'Through the Lens of a Critical Friend', *Educational Leadership, New Roles, New Relationships,* 51.2 (1993), 49–51, (p.50); Thomas A. Dutton, *Voices in Architectural Education: Cultural Politics and Pedagogy* (New York: Praeger, 1991).

Figure 1.
Pictures of the 'lived-in' physical design studio space at Aarhus School of Architecture (AAA), courtesy of Kari Moseng

Three Studio Models

In the studio setting, students are active learners. All cases employ learner-centred pedagogies that put responsibility for learning on the student. Peer-to-peer and collaborative learning are integral pedagogies to encourage a learner-centred approach that reduces competition and embeds a network of social relations, shifting the students from being passive to active learners who share a learning experience, developing skills and knowledge together.[22]

1. The beaux-arts design studio model

The beaux-arts design studio environment is centred around 'constructive conversation' and is aimed to prepare students for the collaborative environment of architectural practice.[23] In this model, students benefit from a rich social dynamic where peer-to-peer, socialised and informal learning can develop.[24] Similar to architectural practice, they engage in problem-based learning through case studies, projects and 'reflection in action'.

In the early years of study, teachers might demonstrate 'reflection in action' through improvisational design in the studio as part of the design process. From the early stages of architectural studies, students are expected to independently (but within a framework of guidance) discover, question, reflect and learn. For example, the teacher might draw together with the student. Thus, the learning environment and the context is particularly important in terms of learning procedural knowledge (procedural knowledge as in knowing how), and conceptual knowledge (as in knowing that/why).[25] The student's previous and ongoing design process work is usually available in the physical design studio and can be brought into the discussion by either the teacher or student. Though useful, this teacher-student dynamic, linking master to apprentice, has a power imbalance, where a student is exposed to the views of mainly one 'master' tutor over the year.

The beaux-arts design studio model is most closely represented by Case 1 the Aarhus School of Architecture (AAA), where the collaborative environment of a studio takes centre stage. Lectures and workshops are fully integrated into the studio to support the design project. Further, in the last semester of bachelor education, students take on extensive apprenticeships, working in an architecture practice of their choosing.

22. Maii Emam, Dina Taha, and Zeyad ElSayad, 'Collaborative Pedagogy in Architectural Design Studio: A Case Study in Applying Collaborative Design', *Alexandria Engineering Journal,* 58.1 (2019), 163–70;William Rau and Barbara Heyl, 'Humanizing the College Classroom: Collaborative Learning and Social Organisation among Students', *Teaching Sociology* 18 (1990), 141–155; Sarah Robinson, 'Peer Assisted Learning within Architecture: The Methods and Benefits', *CEBE Transactions,* 4.2 (2007), 43–53.

23. Kenneth Bruffee, *Collaborative learning: higher education, interdependence, and the authority of knowledge* (Baltimore: John Hopkins University Press, 1999, 2nd edn), p 12.

24. David McClean and Neasa Hourigan, 'Critical Dialogue in Architecture Studio: Peer Interaction and Feedback', *Journal for Education in the Built Environment,* 8.1 (2013), 35–57.

25. Robert McCormick, 'Conceptual and Procedural Knowledge', *International Journal of Technology and Design Education*, 7.1 (1997), pp. 141–59.

This design studio model is predicated on close physical proximity of face-to-face interactions, both teacher-student but also student-student. Students and teachers work together in the shared design studio space, visualise ideas and share visual material, and go on-site and building visits in studio groups. These activities foster knowledge sharing and collaborative learning. This model also fosters the need for 'co-presence', i.e. quiet presence with others in the same space and a sense of togetherness and belonging to a community.[26] This is considered important for an individual's socialisation in the learning environment and for informal discussion.[27] Co-presence with teachers also helps teachers to 'attune to the needs of students'.[28] In formats that are not face-to-face, such collaborative activities that centre around the physical studio presence are difficult to envision.

26. Saniye Bulu, 'Place presence, social presence, co-presence, and satisfaction in virtual worlds', *Computers & Education*, 58, 1, (2012), 154-161.

27. Borsotti and Møllenbach.

28. ibid., p. 3.

2.

The external design studio model

The beaux-arts design studio model, explained above, is a space-reliant model. Without sufficient dedicated physical learning space, students usually have to manage their design projects in alternative arrangements, hence the birth of the external design studio model. Contrary to the beaux-arts model, supporting subjects are generally not integrated with the design studio projects but instead are stand-alone courses, taught in standard departmental classrooms and are separately evaluated. In parallel, students either utilise shared workspaces within the school, or work external to the school, e.g. from home. In this external model, co-presence without a physical space is more difficult to achieve and has to be purposely incorporated by teachers through formally scheduled events that bring students together in the same space. For example, teachers in Case 2 Tampere School of Architecture (TSoA) organise weekly additional topical lectures and (peer-to-peer) workshops where open dialogue and sharing of projects is encouraged. These learning activities are taught as part of the design studio, aiming to create co-presence and to overcome complete separation between design and theory.

On the flipside, separating learning activities from a dedicated physical design studio space also gives flexibility to the teaching methods. One such opportunity is the flipped learning environment. A flipped classroom flips the delivery of teaching, often supported by e-learning.[29] As Case 2 highlights, it reduces face-to-face passive learning and centres face-to-face teaching for active and deeper learning.

29. Robert Beichner, and others, 'The Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP) Project', Research-Based Reform of University Physics, 1, 1 (2007) 2-39.

As Bergmann and Sams state, 'the time when students really need me [the teacher] physically present is when they get stuck and need my individual help. They don't need me in the room there to yak at them and give them content; they can receive content on their own'.[30] The teacher supplies the content via pre-recorded material to be digested by students in their own time and face-to-face time (individually or in groups) is dedicated to supporting the student's application of learning.[31] This approach also allows students to pause, re-watch and research any parts which they find difficult, in their own time.[32] In this studio model, the teachers are both facilitators of learning in designing supporting activities but may also revert to a 'master' role in design tutorials. However, the student is more in control of what they bring and share to the design teaching session, unlike the beaux-arts studio model where the project material is always available in the space to refer to by both teacher and student. Establishing co-presence in the external design studio model is naturally more difficult to achieve without a shared physical studio space, and therefore necessitates the use of discussion groups and workshops.

The blended learning design studio model

Blended learning environment (Case 3, SSoA and Case 4, IDBE) integrates face-to-face and online learning.[33] This enables different approaches to learning and could benefit learning and teaching. Blended learning blurs the boundaries of a physical studio space, as students can continue their learning processes pre-and post-formal teaching, supported by digital technologies.[34]

Blended learning environments must also provide the basic psychological needs a studio provides, such as a sense of safety and familiarity and co-presence.[35] For instance, given that students work in practice while they study, the Case 3 Sheffield School of Architecture, (SSoA) design studio is an evolving model of blended learning, spanning several physical spaces (architect's offices, cafes, private kitchens, etc.) and online environments where distance learning and e-learning techniques are deployed (lectures, workshops, tutorials) (see Figure 2). Similarly, in Case 4 the interdisciplinary design course at the University of Cambridge Institute for Sustainable Leadership, the diverse body of international students alternate between studying remotely and attending residential weeks, when they travel to Cambridge for face-to-face teaching, including the design studio. In both cases, students are connected through the virtual learning environment with each other and with teachers. This provides them with multiple cultures of support, from their university, peers and professional practice.

30. Jonathan Bergmann and Aaron Sams, 'Flip Your Classroom: Reach Every Student in Every Class Every Day', *International Society for FTechnology in Education,* (2012), 4-5 (p. 4).

31. Richard Coyne, John Lee, Denitsa Petrova, 'Re-Visiting the Flipped Classroom in a Design Context', *Journal of Learning Design*, 10, (2017), 1–13.

32. Brenda Danker, 'Using Flipped Classroom Approach to Explore Deep Learning in Large Classrooms', *IAFOR Journal of Education*, 3.1 (2015), 171–86.

33. Randy Garrison and Heather Kanuka, 'Blended Learning: Uncovering Its Transformative Potential in Higher Education', *The Internet and Higher Education,* 7.2 (2004), 95–105 , (p. 99).

34. Russell Osguthorpe and Charles Graham, 'Blended Learning Environments: Definitions and Directions', *Quarterly Review of Distance Education,* 4.3 (2003), 227–33./ and Samuel Helms, 'Blended/hybrid Courses: a Review of the Literature and Recommendations for Instructional Designers and Educators', *Interactive Learning Environments*, 22.6 (2014), 804–10.

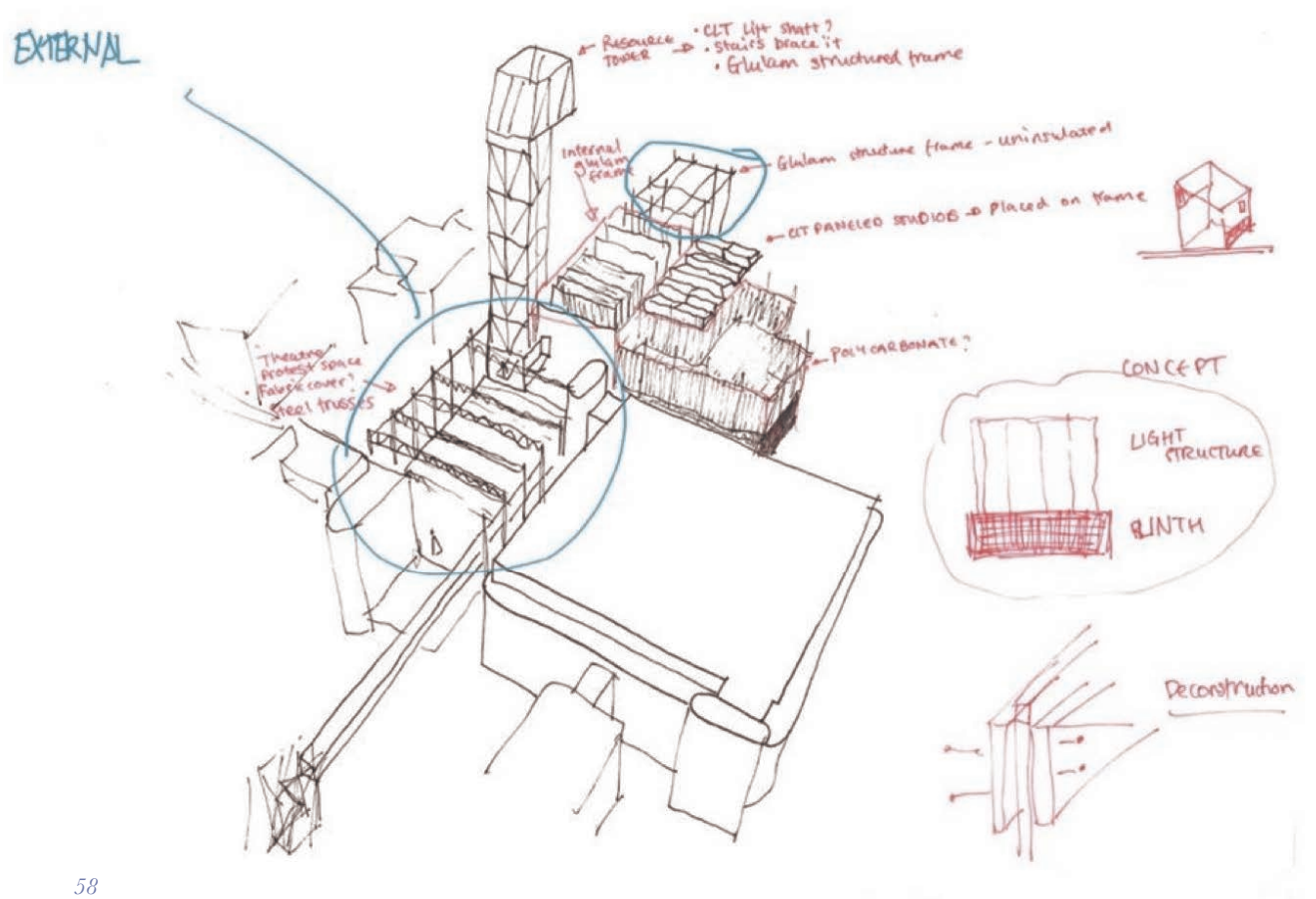
35. Niclas Sandström et al, 'Usability and affordances for inquiry-based learning in a blended learning environment', *Facilities,* 34.7-8 (2016), 433-49.

3.

The virtual design studio: architectural education during the 2020-2021 pandemic

In March 2020, students and teachers in the four case studies started unexpected digital learning journeys, spending the remainder of the semester at home with no in-person interactions with fellow students, tutors or final assessors. Quickly, the learning environment shifted to virtual design studios. In Cases 2 TSoA and 4 Cambridge IDBE, the virtual design studio continued for the remainder of 2020 and into the start of 2021,

Figure 2.
Example of an online tutorial. Courtesy of Aidan Hoggard



while in the other two cases, the 'normal' learning environment was interrupted by periods of virtual design studios as the local guidance of each institution changed. In response to the pandemic, the four cases offer different insights on the roles of online learning, studio culture and peer-to-peer support.

The virtual design studio is a digital studio in which teaching and learning occur across space and time, fostering communication and collaboration through synchronous and asynchronous digital tools.[36] Students across various geographical contexts work together in a digital environment, sharing each other's design process.[37] In this digital setting, the role of the teacher differs from the previous three models. Besides student-teacher design dialogue and transmission of knowledge, the teacher's role expands to include facilitating learning using online methods and tools to enable design studio dialogue. In contrast to a flipped classroom, a virtual design studio allows students and teachers to interface and share work on the design teaching day, much like they would in a face-to-face studio. Simultaneously, students can selectively share their material digitally, which may or may not represent the entirety of their process.

The design tutorial is the pedagogical essence of the studio. In online learning environments, the experience of a tutorial changes. It becomes crucial to manage student activity and engagement, and to build interactive and authentic online tutorial contexts that support the basic psychological needs of students and their learning experience and learning outcomes.[38] Without face-to-face contact, co-presence is difficult to achieve.[39] Yet, it is crucial to establish a feeling of community belonging, thereby 'scaffolding' (i.e. supporting) the complexity of value conflicts as part of reflective practice. For scaffolding to be successful, students must mutually share and gradually internalise this process of constant reflectivity.[40]

36. Ashraf Salama and Nicholas Wilkinson, 'Introduction: Digital Technologies and the Studio', *Design Studio Pedagogy: Horizons for the Future,* (Gateshead: The Urban International Press, 2012), 309–11, p. 310 and Leman Figen Gül, Anthony Williams and Ning Gu, 'Constructivist Learning Theory in Virtual Design Studios', *Computational Design Methods and Technologies*, (2012), 139–62.

37. Jerzy Wojtowicz, *Virtual Design Studio,* (Hong Kong: Hong Kong University Press, 1995).

38. Inger Mewburn, 'Lost in Translation: Reconsidering Reflective Practice and Design Studio Pedagogy', *Arts and Humanities in Higher Education,* 11(4), (2012), 363-379; Murray Lane, Lindy Osborne and Philip Crowther, 'A Blended Learning Approach to the Teaching of Professional Practice in Architecture', *Education Sciences*, 5 (2015), 166–178 and Alla Nazarenko, 'Blended Learning vs. Traditional Learning: What Works? (A Case Study Research)', *Procedia – Social and Behavioral Sciences* 200 (2015), 77-82.

39. Jeff Noonan and Mireille Coral, 'Education, Social Interaction, and Material Co-presence: Against Virtual Pedagogical Reality', *Interchange*, 44 (2013) 31-43; Borsotti and Møllenbach.

40. Puntambekar and others, 'Congruence and friction between learning and teaching', *Learning and Instruction,* 9.3 (1999), 257–80.

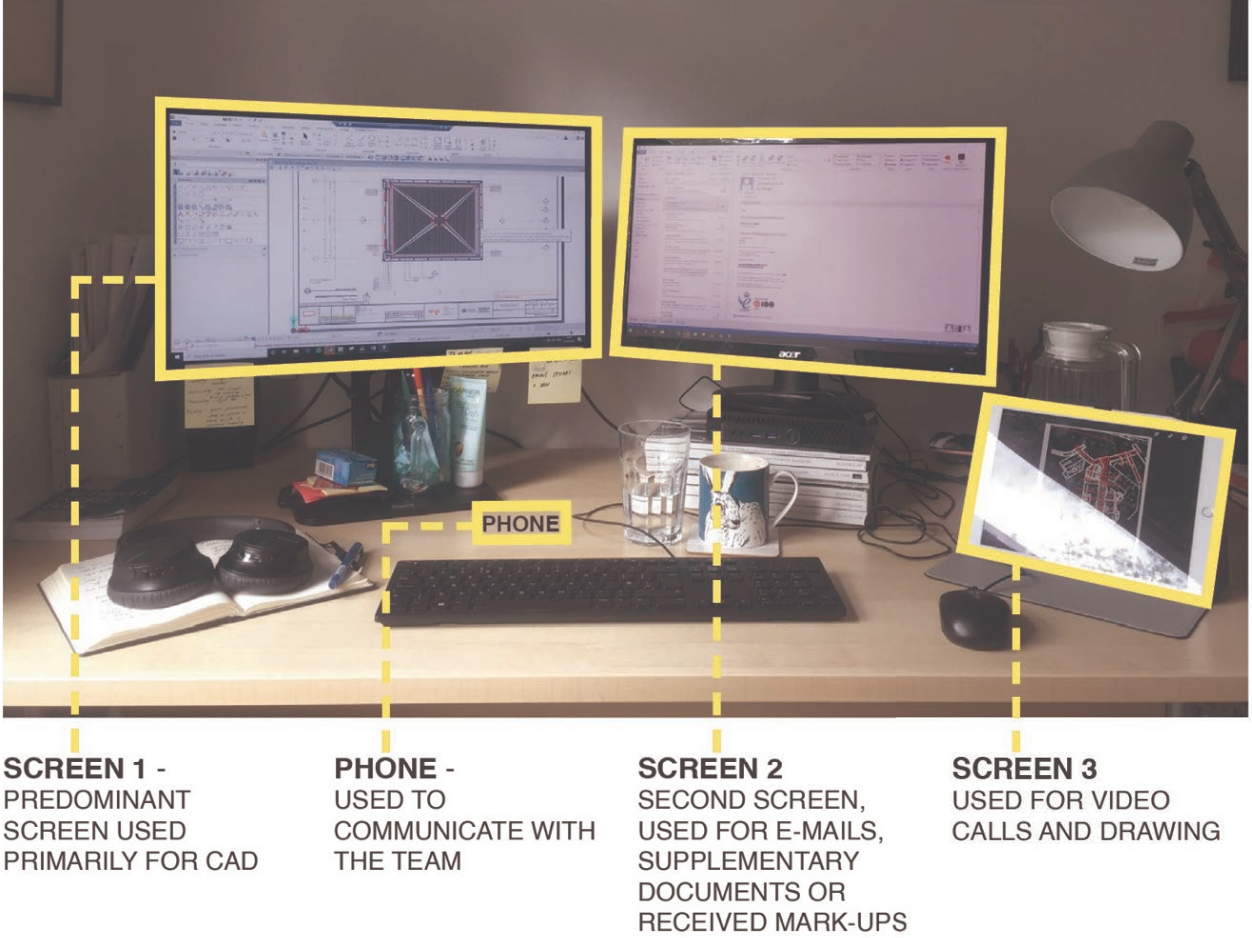


Figure 3.
A home set-up

Discussion The key reflections and lessons learned are further discussed below.

A culture of support is more important than the physical space. All cases experienced that the lost 'culture of support' was more important to replicate than the physical space of the design studio. The cases showed, to some extent, that this could be achieved in a virtual environment through careful selection of different technical platforms. For example, it was found that the use of the digital platform Miro, as in Case 1, enabled students to set up their compartmentalised virtual design studio spaces, mirroring real-life tutor groups (see Figure 4). Students were virtually present in this studio space, being both part of their own sub-group, but also moving between the different tutoring groups as part of the larger studio community.

Students not only shared their work and design process but also interacted and communicated by tagging each other and leaving comments. Teachers and students could also use the virtual drawing tools during video calls. As these virtual spaces were shared, other students could see the tutoring activity happening live and add additional comments and references.

During reviews all 'watching' students were asked to leave questions and comments for each student presenting, actively engaging them within the presentation and increasing peer-feedback (see Figure 4). This fostered a new sense of community and togetherness, encouraging both peer-to-peer and collaborative learning and feedback.

Figure 4.
Examples of an online (bachelor) community studio 'pinboard' for tutor and peer-to-peer feedback, courtesy of Elizabeth Donovan.

padlet

Jenni Poutanen (TAU) ✦ 9 ● 7h

Share You Site Experience

For others, and you, to get different viewpoints & perspectives, we ask you to take a picture of of one particular place, experience, feeling or an interesting issue etc on your site visit. Add some short explanation.

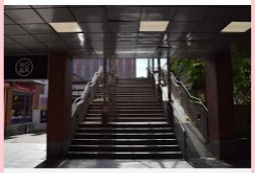
Potential square for a new kind of urban space.

♡ 0

Add comment

Forgotten stairs

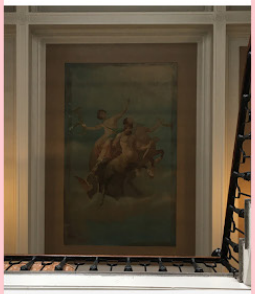
Found the hidden connection from Asematunneli to Pakkahuoneen Aukio



♥ 2

Add comment

If you look up in the entrance stairwell to Tullikamari, there's a fresco there. Went there for ten years without noticing.



♥ 3

Add comment

Hidden

The view and atmosphere on the more private areas inside city blocks is very different

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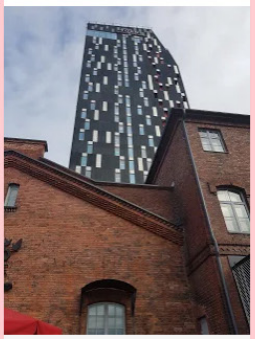
Add comment

Meeting of old & new



♥ 1

Add comment

Variety

If anything, the area hosts a variety of different building styles. Now if only the greenery in the distance would also reach the streets...

♥ 1

Add comment

Little bird

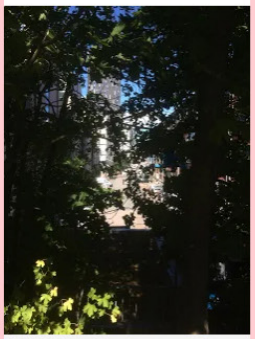
Looked up and noticed some delightful environmental art @Åkerlundinkatu

♥ 2

Add comment

Sneak peek

There are hardly any trees in the area but in this spot they covered almost the whole view. A small glimpse to keep up the interest!



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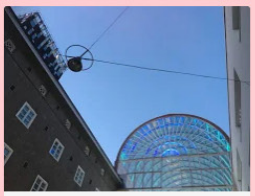

♥ 1

1 comment

Anonymous 3d
Tullintori & Hotel Torni

Add comment

Tullintori

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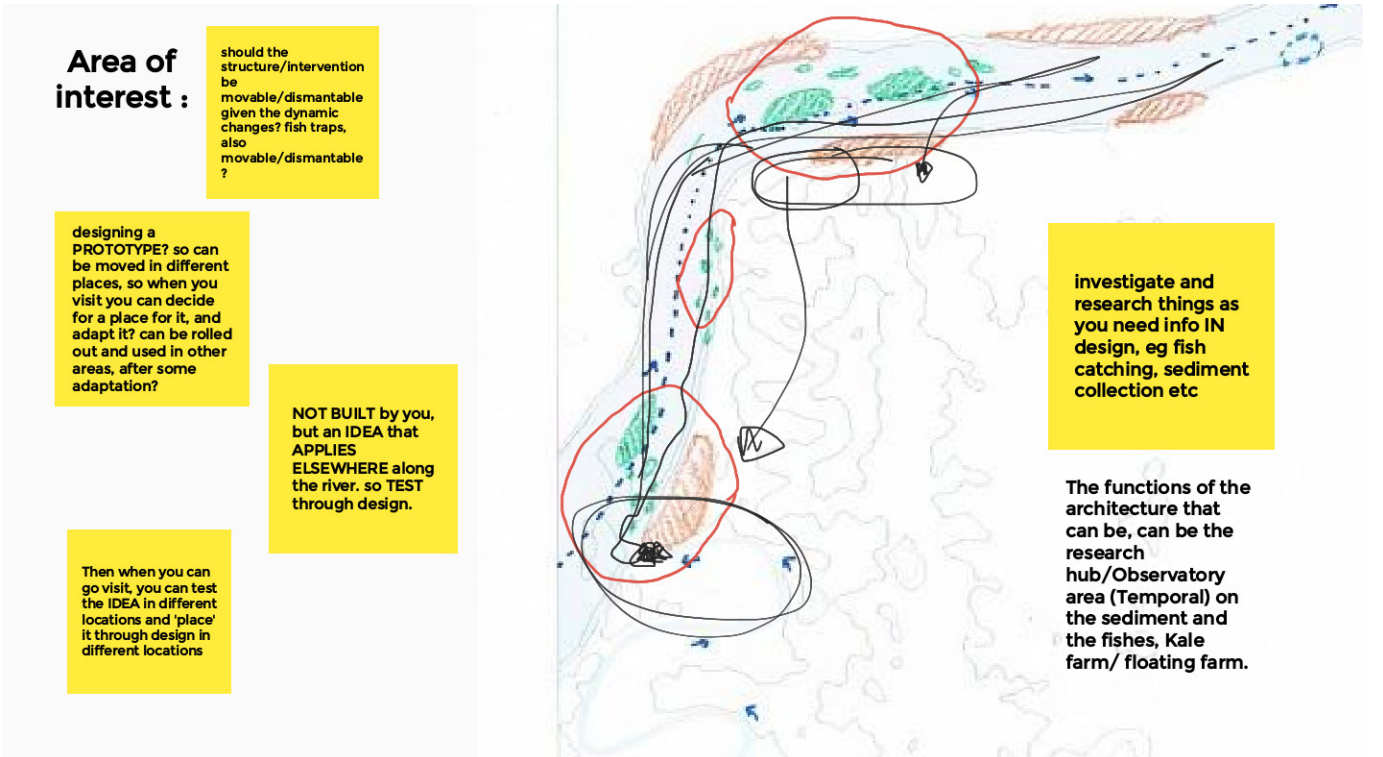
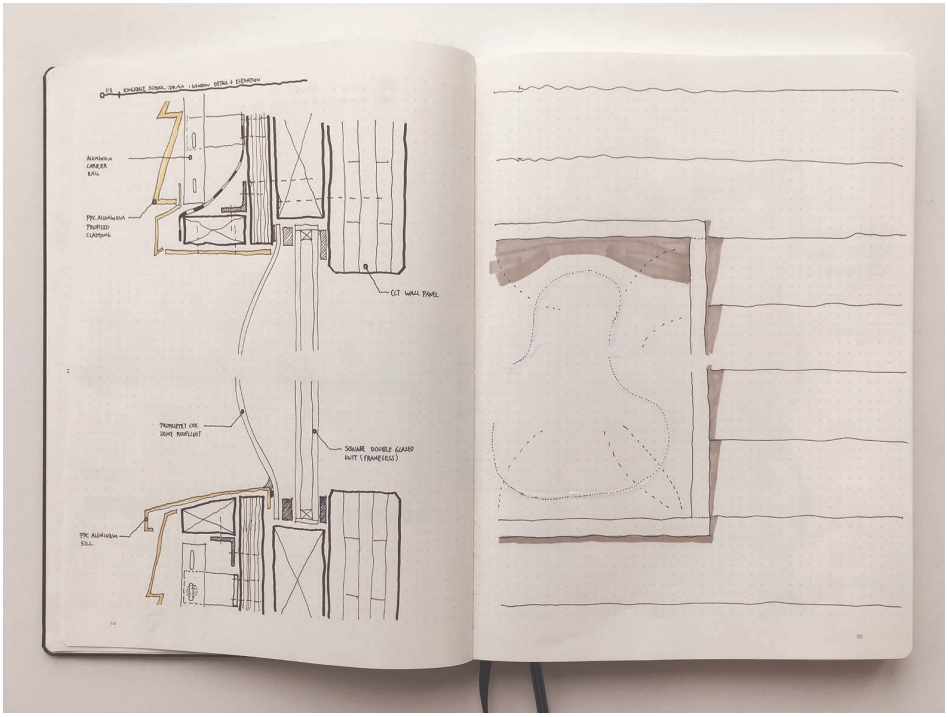


Figure 5-6.
Examples of Padlet (left) and Jamboard (above) for sharing and marking up of ideas and feedback, among students and tutors and peers.

Case 2 also allowed for written peer feedback in interim reviews, in this case using Padlet. Padlet allowed the presence of the entire student community and the uploading of sketches, but functionalities like tagging or virtual drawings tools were not possible in sub-groups (see Figures 5-6). In Case 2 and Case 4, students collaborated through shared screens and online whiteboards with virtual mark-up tools (e.g. Zoom, Mural, and Google Jamboard). In Case 3 the importance of hand drawing for the rapid development and communication of design ideas was retained and became an important part of online tutorials and student submissions (see Figures 7-8). In Case 4, students already primarily designed in studio with digital tools and were used to digitizing hand-drawings for digital presentation. In contrast, hand-drawing was more problematic in Cases 1 and 2.



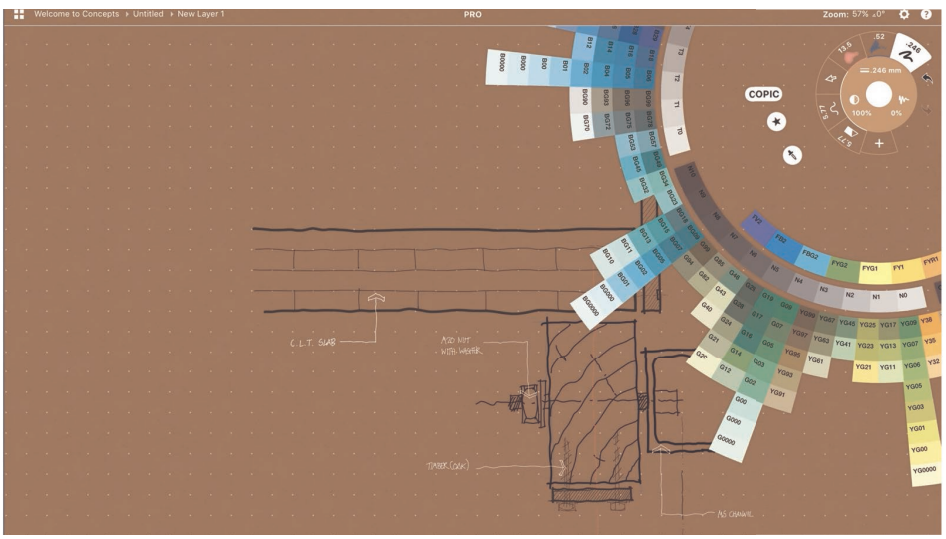


Figure 7-8.
Examples of analogue and digital hand drawings

Figure 9.
(opposite)
Use of virtual design studio as a platform, nurturing student community and facilitating live-drawings. Courtesy of Elizabeth Donovan.

Transparency of the design process

An unexpected and positive outcome of the virtual design studio was that design process work, which often ends in piles of tracing paper under a desk, was made visible. Especially in Case 1, where students could see each others' work on an on-going basis, commonalities were easily found between students in different tutoring groups, increasing peer-learning.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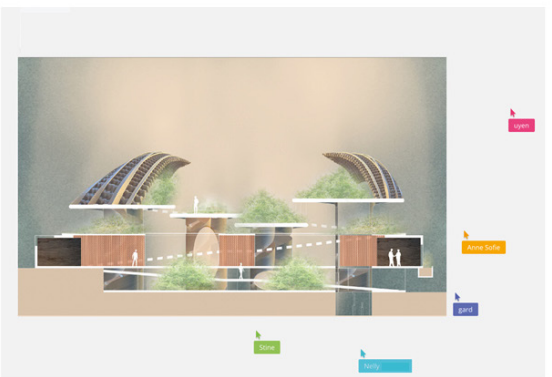
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Structured learning activities

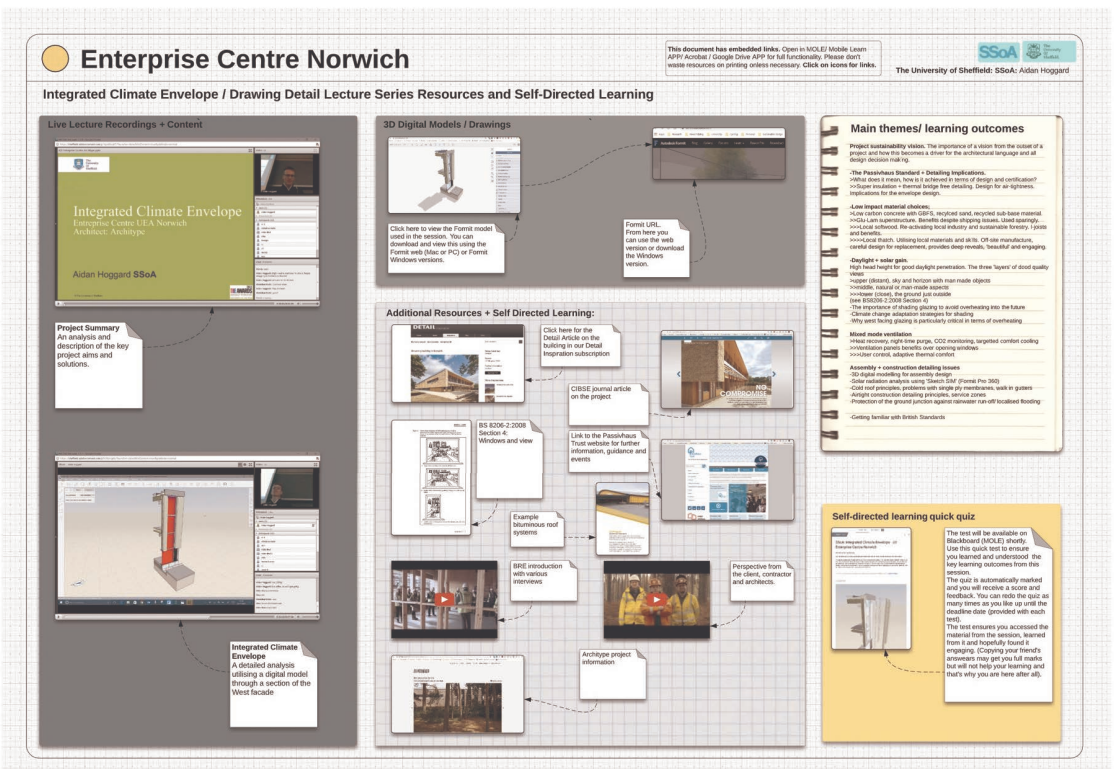
Lengthy online learning sessions are more difficult than face-to-face sessions for a variety of reasons, including concentration, multi-tasking, poor internet, ergonomics and limited access to a quiet working space. Hence, clearly structured learning activities and prepared lesson plans were found to be even more necessary to make online teaching effective. For example, using flipped classrooms with pre-recorded material minimised online taught sessions. However, it is necessary to then apply this new knowledge to online seminars in smaller breakout discussion groups to activate deeper learning in small peer-to-peer groups and create a community atmosphere. Student expectations always need to be carefully managed and this is even more true for entirely virtual environments.[41]

In Cases 2 and 3, interactive Padlets, or worksheets, respectively contained a range of learning resources that allowed students to choose the order and depth of their learning, thus offering 'scaffolding'.[42]

41. Elizabeth Donovan and Sofie Pelsmakers, 'Integrating Sustainability in Design Studio Through Blended Learning', *Conference Proceedings, Education, Design and Practice – Understanding skills in a Complex World,* New York, 2019, (2020).

42. Sadhana Puntambekar and Roland Hübscher, 'Tools for Scaffolding Students in a Complex Learning Environment: What Have We Gained and What Have We Missed?', *Educational Psychologist,* 40.1 (2005), 1–12, and Vermunt and Verloop.

Figure 10.
Example interactive worksheet



In Case 4, instead of in-person building tours and site analysis, video walk-throughs were created by teachers, and on-site experts provided live, interactive question and answer sessions. Student feedback highlighted that they had enough information to make good proposals, despite the drawbacks of the virtual format, which include the lack of personal spatial or material experience of the buildings.

Accessibility and Inclusivity

Student feedback suggests good engagement in smaller group sessions due to the accessible, less exposed and anonymous nature of e-learning tools, encouraging shyer students to participate in safe environments.[43] In Cases 1 and 2, students generally said they benefited from better peer-learning due to better visibility of their peers' projects on-screen in comparison to the print-outs in the physical space. Previous studies of blended learning have reported increased student engagement alongside better satisfaction and benefits to students in terms of presentation and discussion skills, as was observed in Cases 1 and 2.[44] However, in larger online class discussions or lectures, student engagement was often poor compared to the smaller group activities. Whether this was due to the distractions of remote working, the awkwardness of the unfamiliar setting, the limited visibility of other students, or because the power balance between tutors and students had shifted, active student participation in these learning activities was often passive or inconsistent. To overcome this, Cases 2 and 4 found online breakout rooms increased engagement by creating smaller groups.

43. Glen Andrew Hill, 'The 'Tutorless' Design Studio: A Radical Experiment in Blended Learning', *Journal of Problem Based Learning in Higher Education,* 5.1 (2017), 111–25 and Ingrid A.E. Spanjers and others, 'The promised land of blended learning: Quizzes as a moderator', *Educational Research Review,* 15 (2015), 59-74.

44. Afacan, and Güzer and Caner.What Have We Missed?', *Educational Psychologist,* 40.1 (2005), 1–12, and Vermunt and Verloop.

The virtual design studio has the potential to increase accessibility and inclusivity. For example students who are in different geographical locations can take part without the complications of travel. However, in Case 4, segregation by time zone resulted in less diverse groups than would typically be preferred. Case 4 prioritized studio for 'core hours' teaching but this still resulted in some students in extreme time zones attending during less desirable local times. The virtual design studio also requires access to personal computers and good internet connections that some students might not have.

As expected, the courses with a blended design studio model more easily shifted to a full virtual design studio. In Case 3, the Collaborative Practice programme was able to transition to an entirely online mode with less difficulty than the School's

other campus-based programmes. The shift to virtual design studios had much less impact on students and teachers who were already more familiar with online lectures, reviews and tutorials. For example in Cases 3 and 4, due to the independent distance learning aspects, documentation was already available online and in Case 3, students were familiar with the tools.

In Case 3, students benefited from work-from-home arrangements within their professional practice. Subsequently, they were well prepared for the virtual design studio as they already had a home set-up with powerful computing and multiple monitors (see Figure 3), in contrast to many campus-based students who cited the lack of such equipment as significant challenges to their studies.

In design tutoring or seminar sessions, the virtual learning environment also supported the immediate sharing of other material during improvisational discussions, making discussions less abstract, for instance by showing case studies on screen. The virtual environment can empower students to share ideas by using the chat tools or screen sharing. To some extent, the virtual environment shifted the master-apprentice relationship to a more equal peer-to-peer relationship. Interestingly, in Case 3, several students cited that, within architectural practice, online meetings had opened up new experiences, as they were able to join meetings online that they would have never had access to pre-pandemic (see Figure 11). From these experiences, students felt empowered to engage with other design team members about their area of work, which in turn, informed their interests and educational experiences.

Virtual environments can further support flexibility and diversity by enabling external guests to participate in lectures or reviews from other parts of the world, who would otherwise be excluded. This new opportunity was positively utilised in Cases 1, 2, and 4 and was praised in student feedback.

Figure 11.
Student sketch reflecting on virtual design studio

Time

Students and teachers need time to get acquainted with new tools and platforms. It takes time to prepare and distribute instructions and also requires extra time during sessions (e.g. moving from a platform or breakout room to another, restarting, commenting). In all four case studies the same tasks were more time-intensive compared to the teacher's regular workload. For example, online material needed to be available well in advance so that students had sufficient time to watch and undertake tasks. This required foresight in lesson planning and organisation on the day, for instance by breaking up longer sessions into smaller parts. This reduced flexibility for the teachers and students. In Case 4, the organic 'spill over' of activities from structured sessions into free time was not easy in a virtual environment in the way it would normally happen in face-to-face workshops, and engagement opportunities had to be actively programmed.

Conversely, time was saved as the virtual platforms made it easier to add feedback and references, while also referring to the input provided by the other tutors.

Conclusion

This article presents four perspectives from architecture schools in Denmark (Case 1), Finland (Case 2) and the UK (Cases 3 and 4) that suddenly shifted the architectural design studio to a virtual environment during the 2020 pandemic. Each of the four case studies highlights that architecture design teaching can be.[45] successfully conducted through virtual environments and that differing studio cultures call for different levels of online environments and digital tools, depending on the educational structure, and the format and level of study. Reflections based on discussions with students and teachers indicated that there were specific challenges of the shift to virtual design studio, but also unexpected benefits.

45. The reflections presented here only cover selected aspects of our experience and do not touch on many of the physical and emotional realities, nor the issues of digital equality and privilege that are critical to online learning and teaching.

Design studio models that already integrate some level of blended learning, such as Cases 3 and 4, and to some extent Case 2, adapted more easily to the shift to virtual design studio, compared to Case 1 that relies primarily on face-to-face teaching in the physical design studio.

Challenges included the additional time and resources needed to prepare and structure learning activities, and to engage students. It was also found that co-presence, i.e. a culture of support and sense of belonging to a larger community, was harder to foster than in the physical design studio space. A conscious concerted effort is needed to establish studio culture that sustains the culture of support, whether in a virtual or physical environment.

In a virtual environment, it was found that the culture of support could be created within small groups but not necessarily in larger ones. Feedback and research suggest that face-to-face environments are still considered superior to create co-presence, especially for informal discussion and improvisational sessions.[46] Some digital tools and pedagogical methods were also better at supporting co-presence than others, especially those that enabled small student groups to engage in real-time and make their work visible to wider students. This also had the unexpected benefit of making the design process more transparent, enabling students to find commonalities and connections that would otherwise have remained hidden.

46. Borsotti and Møllenbach.

Another unexpected benefit was that of potential increased inclusivity and accessibility, especially in Cases 1, 2 and 3. Peer-to-peer engagement in particular was supported well by digital tools that allowed for equal reflection and easy visibility, while flipped classrooms supported self-reflection and learning at the student's own pace. Engaging students in peer-to-peer feedback during project reviews was also supported by digital tools, while this is often neglected in face-to-face sessions. Subsequently, some digital learning and teaching tools applied in the virtual design studio setting could be beneficial if transferred to face-to-face sessions. These include actively inviting peer-to-peer feedback, supporting sharing and collaborative work, and inclusive participation (e.g. incorporating blended learning to enable some students to study online). Some aspects of blended learning could also open up learning activities to invite global speakers to participate without needing to travel. The growing need for spaces of collaborative knowledge creation – be it campus facilities or online learning platforms – supports blended learning and highlights how shared knowledge practices are becoming more prominent and important at different levels of education.[47]

47. Kai Hakkarainen and others 'Communities of networked expertise: Professional and educational perspectives' (Amsterdam, The Netherlands: Elsevier Scientific Publ. Co., 2004); Sofie. Loyens and David Gijbels, 'Understanding the effects of constructivist learning environments: Introducing a multi-directional approach', *Instructional science,* 36.5-6 (2008), 351-57; Craig Hamilton, 'Fusion building: new trend with some old roots', *Planning for Higher Education*, 37.2 (2009), 44–51 and Niclas Sandström, 'From Needs to Deeds: User experience informing pedagogical and sustainable campus development', *Helsinki Studies in Education* 82 (2020).