The Design Studio of the Future: Insights from A Practical Experiment in Remote Collaboration

Lars Erik Holmquist[1][0000-0003-0229-2345] and Sam Nemeth[2] [0000-0001-9801-6956]

[1] Nottingham Trent University, 50 Shakespeare St, Nottingham NG1 4FQ, UK
[2] Poppe & Partners, Tuinstraat 118, 1015PH Amsterdam
(lars.holmquist@ntu.ac.uk, sam.nemeth@gmail.com)

Abstract. A *design studio* is sometimes seen as an example of an almost ideal creative workplace – a rich and dynamic environment that facilitates many different types of collaborative work. In this project, we aimed to recreate the positive features of a design studio in an educational and workplace setting using distance-spanning digital technology. We first set up a series of experimental collaboration systems to facilitate teaching and research at a university during the early days of the Covid pandemic. We quickly found that many concepts proposed in the research literature were not practically feasible. Instead, we constructed realistic solutions using off-the-shelf hardware and software that afforded novel and efficient ways of blending co-located and distance collaboration. This included informal interaction settings with one or multiple participants both online and in-person, as well as formal hybrid teacher/student presentations. From this we learned that although much of the required hardware already exists, it is not generally being used to its potential. We also found much that the standard meeting software is not fit for this kind of creative collaboration settings. The insights from this will support the creation of better support for combining remote and in-person creative work.

Keywords: Remote collaboration, telepresence, design practice.

1 INTRODUCTION

At the start of the Covid pandemic in 2020, there was uncertainty about what would happen to office work and teaching. At first, many thought that things would just go back to normal as the pandemic ebbed out after a few months. Then, as the reality set in that this would not be over in a long time, it looked like we would never go back to the "real" office again. Distance working became the norm, and actually turned out to be quite efficient in many respects. But at the same time, it has been acknowledged that by not having a shared, co-located workplace, creative and collaborative work becomes difficult, and informal communication suffers. Today, in the post-pandemic world, many workplaces are still in a period of calibration, where staff and management are trying to figure out the best balance between on-site and remote work.

In this case study, we report from a project called *The Design Studio of the Future,* where we explored ideas around the future of creative and collaborative work and education in this emerging new world. It was proposed as an early reaction to the pandemic, and throughout 2020 and 2021 we carried out a number of small-scale experiments across universities in UK and the Netherlands. In these, we wanted to use technology as efficiently as possible to support creative work and learning, both online and in person. The project set out with visions of creating completely novel ways of interacting, but because it was not possible to produce bespoke hard- and software in the pandemic, we instead used mostly off-the-shelf technologies in new ways – something that turned out to be not a negative, but a major learning from the project.

2 THE DESIGN STUDIO OF THE NOW

A design studio is often mentioned as an example of an ideal creative and collaborative workplace. Most of us can easily imagine the typical (although idealized) design studio as a rich, creative and dynamic environment. Design studios are typically large, open plan spaces that have facilities for many different types of work. People move between different areas, taking advantage of the most relevant equipment and capabilities. The space allows for concentrated, individual work as well as fostering spontaneous communication. Residents see what their colleagues are doing; they can instantly turn to someone for help if they get stuck; they can pick up on interesting ideas from each other and generate new projects. The air is buzzing of energy and excitement, creating a positive atmosphere that inspires even better and more creative outputs. This is a place where both individual and group work is exponentially improved by the presence of other people as well as the physical and technical resources of the space.

But then came the pandemic. Social distancing and work-from-home mandates enforced distance work, and when no one is there, all the energy of the studio itself is lost. Video conferences and remote meetings impose rigid limitations and limit spontaneous collaborations and workplace awareness. Despite many workers feeling that they are equally or even more efficient when working from home, it was clear that the design studio (as well as many other workplaces) became a shadow of its former self during this time. And even years after the pandemic, many workers and educators are still preferring to work from home, despite the loss of the advantages of the in-person environment. So how could we combine the advantages of flexible workplaces with the buzz and energy of a lively physical space such as a design studio?

3 WHAT (WE THOUGHT) WE WANTED TO DO

Motivated by this vision, we provisioned a project to explore *The Design Studio of the Future.* We wanted to create a technology-supported environment that ideally would take the best of both distance work and in-person collaboration. The project was set up as a collaboration between a UK university, and a university in the Netherlands. It was aimed at supporting a specific educational case, the *Interaction Design* undergraduate program at the School of Design, as well as the research and teaching staff associated

with the program. We received a small budget to purchase equipment and pay for a part-time researcher.

In the original project plan, we said that we would create "an environment where students and teachers are able to share space both physically and virtually, in formal and informal collaboration, thus re-creating the atmosphere of a fully co-located design studio." Specifically, we wanted to implement and test a series of concepts that touch upon key activities of the design studio, including:

- *Shared Media Spaces:* Always-on, informal audio/video spaces that tie together virtual and physical locations to foster collaboration.
- *Physical-Virtual Workbenches:* An augmented reality-based setting for doing hands-on design work that can be shared by remote users as if they were in the same room.
- *Ambient Cues:* A set of simple displays and devices that sit in the background of the users' attention communicating subtle social cues, such as presence or activity.

These ideas were all heavily influenced by well-established human-computer interaction research concepts, including *media spaces* developed as early as the 1990's in the EuroPARC research center [1], the EuroPARC *RAVE* system [3], as well as MIT's Tangible Media Group's *Ambient Media* [5]. It is also related to other Covid-inspired collaboration and ambient awareness projects that took place in parallel, such as Royal College of Art's Yo-Yo Machines [2]. Our original intention was therefore to build and test a number of novel and bespoke interfaces that would build upon these ideas as research prototypes. We intended this as an exploration of user interface technology, going beyond existing interfaces to demonstrate novel ways of distance interacting. However, what we actually ended up doing was something different.

4 WHAT WE ACTUALLY DID

The project was limited by a number of real-world constraints. The first was that unlike what we had initially believed, the Covid pandemic did not go away. This meant that we were very limited in our ability to hold in-person classes and meetings. It also meant that the collaborators could not travel between UK and the Netherlands during the duration of the project. The second limitation was that we only had a very limited budget for equipment (~1000 GBP) and no access to maker facilities and workshops, as these were all shut down during the pandemic. Finally, we had to look at the reality of our teaching and research load, and use the funding to find realistic ways of supporting this, instead of developing novel – but ultimately less useful – design concepts. Taken together, this meant that if we actually wanted to achieve something practical, we would have to back away from the lofty intention of building entirely novel user interfaces, and instead work with off-the-shelf materials that we could adapt to our needs. In this we were guided by the concept of *Conjoint Control,* a practical set of guidelines that stresses using off-the-shelf parts, user communities and soft deployment to create usable physical user interfaces in real-world settings [1].

In order to work within these limitations yet produce practical results, we carried out a number of experiments using existing and/or low-cost equipment. We stayed as close

as possible to the design brief, while at the same taking advantage of readily-available resources, which allowed us to work flexible and fast, providing us with the opportunity to test out a number of different possibilities. Going by the original intention, this is what we did.

First, we created a shared media space, by setting up a system in a shared area, the lab kitchen. It consisted of a large-screen television connected to a computer, a high-resolution webcam, and high-quality room microphone. We designated a user in a standard telecommunication software. We then let the software run continuously, so that anyone could connect to the large screen in the kitchen and "drop in" to whoever happened to be there. In theory, this provided a media space at a much higher quality and lower cost than the original media spaces constructed in the 1990s. We expected to have our shared, informal meeting place benefit both local and distance workers.

In reality, we turned off the system after the first few hours. It turned out that for the staff and students physically present in the space, the "creepy" factor of the system was much higher than we had imagined. It was immediately obvious that nobody wanted there to be even the smallest chance of someone else remotely listening in or observing when they were interacting informally in the kitchen, or even just hanging out by themselves. Thus, despite many positive reports in research papers on "ambient awareness" and informal communication over shared media spaces [2,4,5], this barrier simply was not surmountable. We did not turn the system on again.

The project plan also envisioned a shared workspace where physical and digital work was shared as if all participants were in the same room. However, due to the limitations with social distancing all Interaction Design students were working remotely from home. Staff and PhD students could come in during certain periods, as long as they were socially distanced. Some were still not able to come in due to being in risk groups or other reasons.

We decided to approach the problem very practically. Rather than trying to create an augmented reality space or a hologram representation of other users, we decided to leverage existing technologies to make it as easy as possible to collaborate. For meetings where most participants were onsite, we set up individual access through dedicated computers for those who could not come in in person (Figure 1). That meant that they could participate in in-person meetings remotely on an equal standing to those in the room.

Fig. 1. Blended interaction with one online participant joining on a single computer (circled), getting equal standing to in-person attendants.

For blended meetings we set up a dedicated meeting place in an informal area, the kitchen (Figure 2). This recycled the high-quality monitor, camera and microphone from the media space experiment. This inexpensive set-up worked very well: through the large screen and high-quality visual/audio connection, it almost felt like everybody was in the same room. By placing it in an informal space rather than a meeting room, it was readily accessible and less stilted than more organized meeting equipment. Throughout the pandemic the lab continued to use this set-up for all kinds of interactions. It is worth noting that this simple solution, costing less than £1000 in total, was vastly superior in quality, and was used more, than the very costly dedicated video-meeting equipment that was installed by the university's IT team.

Fig. 2. Blended interaction with multiple online and offline participants getting approximately equal standing.

For the Interaction Design undergrad program that had originally been intended as the setting for the project, we could only interact with the students remotely due to Covid restrictions. However, we adopted the above meeting system so that the tutors could attend the final presentations from the university (Figure 3). By using personal laptops for chat and textual feedback, tutors got a back-channel to discuss and comment the student work, while watching the presentation together on a large screen. This at least gave the students an approximation of having a live audience for their presentations, and constituted a better experience for the teaching staff than attending from their own home/laptop.

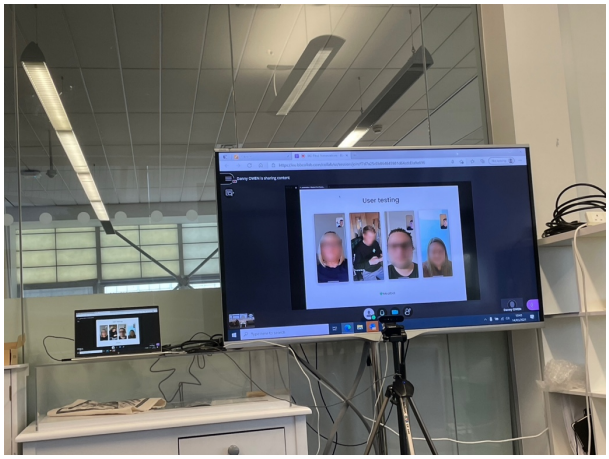

Fig. 3. Attending the final presentations of the Interaction Design undergraduate class, with tutors seated socially distanced in the university while viewing on a large screen and interacting using separate laptops.

Finally, in addition to these installations, we also took advantage of other technology to improve the functionality of existing software. We added a commercially available foot pedal to out remote meeting software to allow the user to shut down either video, audio or close the connection with one tap of the sneaker. We invested in affordable camera stands that made it possible to change the position of the webcam, to easily show tangible results as well as to establish a more attractive image on the webcam than the frog perspective that is inherent to using a built-in webcam on a generic laptop. These simple additions greatly improved the remote working experience at a very low cost.

5 WHAT WE LEARNED

Despite the limitations, we learned a lot about the potential for using technology to create a vibrant “design studio of the future” from these experiments. We saw how simple and inexpensive pieces of equipment could be leveraged, but also that the current software model for distance communication is deeply flawed.

5.1 The needed hardware exists but it is not used correctly

Technology support for distance work seems to fall into two categories. It is either a personal general-purpose machine, typically a laptop, being used for teleconferencing simply because there are no other resources. This is the typical situation that millions of workers found themselves in when suddenly confined to working from home. With many university workers (including us) denied access to their workplaces and equipment, they were limited to whatever laptop they happened to have been assigned when the pandemic struck. Most laptops unfortunately have very bad AV capabilities, including low-resolution cameras, limited-range microphones, and low-quality speakers. This severely limits the experience and makes working remotely much more difficult.

On the other hand, there is the high-end formal meeting room equipment that started to be installed by IT departments by the end of the pandemic. These expensive installations were simply not fit for purpose. They relied on only allowing one type of software (in our case Microsoft Teams) and had all kinds of built-in functionalities that were rarely used but made the system less intuitive, such as automatically focusing on movement in the camera view. By being placed on a wall at the short end of a large meeting room table, they drastically limited the types of interactions that could take place between in-person and remote viewers, as the microphone was too far away from most participants; the camera could not properly cover the whole space; and the meeting room participants were facing each other rather than the screen. Even worse, and surprisingly, the audio and video quality of these installations was significantly worse than our low-cost solution, with both cameras and microphones being sub-par quality in addition to being badly placed. All of this made the “official” meeting systems that the university invested in practically unusable, whereas our cobbled-together “budget” system continued to be used.

We do believe that there is a middle ground that this experiment demonstrated, which is to provide wide access high-quality (but inexpensive) equipment including group microphones, HD cameras, and large consumer screens, to facilitate informal as well as formal meetings. This is a grassroots, practical approach that will be cost-effective and provide a more flexible interaction with a higher audio and video quality.

5.2 The existing software is not suitable, and it needs a drastic re-think

While the hardware components were fairly easy to re-combine and put into new settings, the software for remote meetings and collaborations turned out to be a much more difficult proposition. Through the experiment we used Microsoft Teams and Blackboard, as they were the university mandated software systems; however, the issues are the same with other commercial software such as Zoom, Skype, etc.

The main problem with the software has to do with the one user – one connection paradigm. Whereas we were often 3-5 people using the suite in the lab, Teams would not acknowledge this, and instead treat every user account equally. In particular, this means that the visual weight (i.e. window size) of each user account is the same, with the consequence that accounts with multiple participants are treated exactly as a single user/participant. We often found that it was hard for remote users to decipher what was

going on in the group room as the faces and postures of a group of 3-5 people confined to a very small square were difficult to read. It was also hard to determine who had the "word" in a lively discussion, as co-located users tended to communicate with each other directly, something that often did not translate to the remote participants.

The other issue with this model came when we had single users join through dedicated computers. There is simply no way in Teams (or any other software we know of) to allow several screens/workstations take part in a blended meeting at the same time. The model is set up to show all users on all screens, assuming that they are not co-located. That meant that we had large difficulties to get the system to work when 2-3 people joined and were displayed on individual computers. One of the main issues had to do with audio, because if we had two or more machines joining at the same time, they would feedback and create a noise that made meeting impossible. In the end we only used this approach when a single user was remote (as in Figure 1), and when there were more remote users, we used the large screen (Figure 2) (which as noted came with its own problems).

This has led us to conclude there is need for a drastic re-think on teleconference and collaboration software. In particular, multiple users connecting from multiple places and multiple devices are simply not served in current systems.

6 THE DESIGN STUDIO OF THE (NEAR) FUTURE?

As the world is still recalibrating after Covid, it does seem that remote work is here to stay, especially at universities. At the site of this experiment, we initially saw only a small fraction of the staff return to the office after the pre-pandemic. Official meetings continued to be held remotely, even when all attendants were in the same building. There was no support provided for blended or informal workplace communication, and the centrally installed systems continued to be inadequate. It is not an exaggeration to say that a large part of the vibrancy and creativity of this particular school was lost after Covid, and it would take much work to gain it back.

Yet inter-personal communication is still necessary for creativity and learning. Even in remote or hybrid situations, creativity could be much better supported if existing technology was applied in more useful and flexible ways, and if meeting software would be better adapted to a more comprehensive range of different remote and in-person situations. We believe our experiment shows that there are simple, low-cost solutions to many of these problems, but there is need for a bottom-up re-think of technology for remote, blended and in-person meeting and teaching going forward. Only then will we see a remote or blended "Design studio of the future" that is as vibrant as the physically co-located design studios of today.

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