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# ONLINE PARTICIPATORY TOOLS IN CLASSROOM AND RESEARCH SETTINGS

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## ABSTRACT
Collaborative engagement in research and education often involves the need for a shared workspace among participants. With improved web-based technologies, and limitations to in-person interactions presented by the COVID-19 pandemic, educators and researchers need to adapt their methods and tools to support meaningful engagement. We reflect on our experiences and iterative experiments navigating these challenges in the domains of design education and design research. As design educators, our team utilized various online platforms including video conferencing, whiteboards, spreadsheets, surveys, and polling tools, to support teaching and student collaboration. As design researchers working in the domain of maternal healthcare, we borrowed from our experiences in the classroom and applied some of these tools to our research with patient and clinician stakeholders, to support data collection and research team collaboration. In this paper, we elaborate on these experiences by drawing from examples across our teaching and research activities to share key strengths, challenges, and considerations of the online workspaces, with a particular focus on online whiteboards. We compare the two settings and reflect on barriers and facilitators of online engagement specific to these. Lastly, we suggest recommendations for designing online activities and selecting appropriate online tools based on the objective, contextual needs, and the affordances of tools and activities. Our findings may support decisions of educators, designers, and researchers in planning for online engagement.

*Keywords: Participatory design, participatory research, design education, design research, technology, design for healthcare*

## 1 INTRODUCTION AND LITERATURE REVIEW
Traditionally, activities in the domains of design education and research have largely relied on methods of in-person engagement and collaboration. The work and culture in design programmes are often built around the of a 'studio' space. In research, particularly in qualitative work, the focus of engagement has been in-person, with artefacts, and/or observational in the naturalistic setting of the participants. With the current technological developments of online tools and with pressing global issues such as the COVID-19 pandemic, various sectors have had to adapt their processes. Education and research are no exceptions, leading to a necessary reconceptualizing of the classroom, studio, and the research site. Both sectors have utilized online tools to support collaboration, communication, data gathering, and analysis.

### 1.1 Usage of online tools in education
In the education space, utilizing online tools brings various general advantages. Integrated platforms such as Moodle [1] are now prevalent in many educational settings. Educators can closely monitor student progress through online wiki platforms such as MediaWiki [2] and Google Docs [3] and are able to provide more detailed feedback than possible by non-technology supported means [4]. Yet, a nuanced picture considering the context of usage and specific attributes of the tool offers a clearer picture. Hidayanto and Setyady's analysis of technological characteristics driving usage of collaborative tools highlights the importance of ease of use and perceived usefulness of technologies [5]. Hsu and Shiue analysed the relationship between various 'presences' at play in an interdisciplinary project utilizing Google applications, based on a Community of Inquiry framework, which identifies core elements of teaching presence, social presence, and cognitive presence to sustain purposeful inquiry and meaningful

collaboration [6], [7]. Hsu and Shiue's findings suggest the positive influence of social presence on cognitive presence, highlighting the impact that synchronous aspects of online communication can have on effective engagement. A study of postgraduate service and interaction design education by Lee et al. offers a further detailed understanding of technological affordances driving the quality of interactions [8]. In their study of Slack [9] as a platform in the classroom, affordances such as the ability to create multiple discussion channels, visibility of digital avatars, and the focus on the communicative exchange were connected to the conversational and flexible quality of interactions the students had.

### 1.2 Usage of online tools in research

Due to the COVID-19 pandemic and technological developments, researchers also have had to adapt to using online platforms, particularly for communication and data collection. Some of the reflections of researchers in this space have included using these technologies in Community Based Participatory Research (CBPR) [10], interview and document analysis study [11], and focus groups [12]. The reflections of these various researchers, coupled with Pocock et al.'s [13] methodological commentary, suggests that there are both advantages and disadvantages across all aspects of research to utilizing online tools. For instance, by virtue of utilizing online tools, access to participants may be increased for populations across geographic distances yet may be limited to participants with internet availability and skill. Considering an example of ethical issues, privacy for participants may be supported through the flexibility of online platforms, yet it may be compromised if the participants do not have access to a private physical setting in which to attend the research activities. The studies also reflect on how the researcher's role had to evolve, such as the role of the co-moderator of activities to involve addressing potential technological and logistical difficulties.

## 2 OUR EDUCATION AND RESEARCH EXPERIENCES

### 2.1 Education

Two authors are educators at North Carolina State University (NCSU), which is a large research university in the South Eastern United States. The findings of part of this paper are based on experiences in a graduate level industrial design studio course. The students in this course come from various disciplinary backgrounds and gain an experiential understanding of the design thinking process while refining fundamental skills learned in prior courses such as research, sketching, and prototyping.

The graduate industrial design studio course operated in the academic year 2020-21. It was conducted remotely, with the students and faculty interacting with each other in online environments. The course is distinct from typical university lectures as it meets for a longer duration - three to four hours per session, between two to three times a week. The course requires interaction-focused experiential work where students test, observe, experiment, or practice industrial design in a hands-on environment. The assignments for the course involved the students working both individually and in groups.

### 2.2 Design research

We are also researchers in the Postnatal Patient Safety Learning Lab, a multi-university research project sponsored by the Agency for Healthcare Research and Quality (R18HS027260). Our team is distributed across The University of North Carolina at Chapel Hill, The Ohio State University, and NCSU. The project aims to improve maternal and infant postpartum care through improved safety, equity and overall quality of care. Our role as researchers has involved generating new knowledge with multiple groups of stakeholders including birthing parents, companions, and healthcare professionals. We are co-developing solutions with these participants, in coordination with our research partners who are experts in domains including systems engineering, nursing, paediatrics, and implementation science.

In our research project, we have operated by virtual means in collaboration with research partners and stakeholders. Throughout our research, our goal is to better understand the experiences and perspectives of stakeholders through qualitative research methods such as interviews, and participatory co-design workshops. We have conducted activities to engage with parents, healthcare professionals and research partners, through open conversations and hands-on activities. Examples of activities have been creating reflective journey maps to help prompt sharing with depth. These activities have also involved both individual and group work for research participants.

Since the start of the Coronavirus pandemic in early 2020, we have had to adapt our processes to fit the constraints this issue brought to our work. Through this transition, we leveraged new approaches to

education and collaboration by utilizing various online participatory tools to support our research and teaching. In the graduate studio course, the online tools have primarily supported synchronous and asynchronous forms of collaboration among the students and teaching team. Whereas, in our research work, the online tools have primarily supported data collection through our primary source activities, in addition to secure online data management and collaboration and communication with our research team. In this paper, we leverage our experience of both these settings to reflect on the effectiveness of the online tools across both contexts. We share key strengths, challenges, and considerations of online platforms, and make recommendations for choosing online tools based on contextual needs.

# 3 BENEFITS AND CHALLENGES OF USING ONLINE TOOLS

## 3.1 Our usage of online tools in education

In the graduate studio courses, both synchronous and asynchronous collaborative activities were supported by the usage of online participatory tools. Class sessions and one-on-one meetings occurred over the online video conferencing application Zoom [14]. We primarily used the online whiteboard tool Miro [15] as a visual workspace and repository. Over the duration of the class period, one-on-one meetings and group discussions were conducted over video conferencing and simultaneously, the virtual whiteboard served as a shared visual workspace, to communicate course goals, collect research findings and ideas, and document the process. Additionally, the virtual whiteboard supported asynchronous activities between discussions by enabling the addition of comments, documents, and links. Hence, it worked not only as a shared visual workspace but also as an asynchronous communication tool and a repository for documenting multiple aspects of the projects.

We initially set up the workspaces with a basic framework for the students to build upon, such as by segmenting the workspaces by different kinds of content, work by different students, or different phases of the projects. Assuming some students would be new to the tools, we included informative legends or keys for various functions and orientation to the workspaces. As the project continued, students adapted the workspace to their processes and needs.

In general, we found this setup to work well in the graduate studio course. The students appeared to be very comfortable with using the technology and had a quick learning curve. By having a view of their own work and that of their peers, we believe that this set up encouraged cross-peer learning and reflection on ways to improve one's work. Screenshots of the online repository of work overtime were even used directly in some student presentations to show their process.

Through synchronous collaboration, the online whiteboard enabled the students and teaching teams to have a full view of the progress of the project at one location, simplifying and centralizing management of project data. Students were able to conveniently view other students' work and offer their critiques. This led to streamlining discussions and activities during the class periods and meetings.

Between direct engagement, students were also able to use the whiteboard for asynchronous collaboration. This enabled students to keep track of not only their own progress but also that of their classmates. Students were able to experience the complete arc of each other's progress, rather than just at significant milestones as would be afforded by traditional in-person design education. Similarly, the teaching team were also able to follow students' progress in a more continuous manner. The students and the teaching team were able to offer ongoing critique through comments and links.

Yet, we noticed some drawbacks to the setup, too. The human connection among students and between students and the teaching team was negatively impacted. More recently, we are noticing that the whiteboard may not support in-person or hybrid interactions as effectively as it did with completely online experiences. Now that we are transitioning to in-person and hybrid forms of teaching in 2022, we notice that the online whiteboard is used as a form of digital repository but less as a collaboration tool.

## 3.2 Our usage of online tools in design research

In our research experiences, the online participatory tools primarily supported synchronous activities interspersed with some asynchronous activities, with our research partners and with stakeholders. The online tools served the purpose of collecting data, synthesizing, and organizing it, and also to support communication and alignment between participants. Here too, we utilized the video conferencing application Zoom [14] for discussion in parallel with a shared visual workspace. We used various forms of shared visual workspaces ranging from whiteboard software like Miro [15], Lucid Chart/Spark [16] and Google Jamboard [17], to adapting cloud-based versions of other productivity tools such as

Microsoft Word [18] and Google Sheets [19] into workspaces. Additionally, we used survey tools such as Qualtrics [20] and polling tools such as Poll Everywhere [21]. For asynchronous communication and secure file sharing with our research partners, we used Microsoft Teams [22]. Drawing from our experiences in the graduate studios, we set up these workspaces with informative legends or keys to orient participants and to explain how to use the software, in addition to reserving time at the beginning of the workshops to help participants access and begin using the software, with clarification as needed.
Our initial expectations were that these tools would be effective to facilitate engagement, as they largely had been in our experiences with the graduate studio. Generally, the tools enabled us to collaborate with the team across geographic locations, since research partners are located at multiple universities in the eastern United States. Stakeholders for our research such as patients and healthcare team members were also only accessible to us by virtual means, due to the constraints of the pandemic. The online tools certainly brought the benefits of access to these collaborators. Because of our interactions with our research partners being remote, we were also able to have meetings more frequently than we would have, compared with when we met largely in-person.
We encountered challenges in supporting participation due to varying levels of comfort with technology. In some situations, participants chose not to utilize a certain tool or feature to communicate their ideas. For instance, some participants chose not to utilize an online whiteboard to share their thoughts, instead opting to only verbalize. In one instance, participants were having troubles with logging into/signing up for the whiteboard software we were requesting them to use. As a result of such difficulties, we found that it also often took us longer than expected to orient participants and address any logistical difficulties. Participants also logged in using different devices such as phones in addition to computers. Initially we had not anticipated this and hence our activities were not accessible by phone.
Regarding data collection, the combination of a shared visual workspace and discussion over video call enabled the collection of a rich mixture of open and close-ended data. For example, one workshop activity involved recording stakeholder needs, along with assigning these needs into bounded categories. For such a prompt, participants were able to verbalize their thoughts with the group while creating virtual post-it notes to record their ideas – these led to the generation of open-ended data. At the same time, they placed these notes into bounded categories on the workspace representing close-ended categories – this led to the generation of close-ended data. As a result of participants recording their ideas by virtual means, we had the benefit of having a large part of our data digitized by the end of the workshops and ready for further analysis. Having a shared workspace also enabled the continuation of data collection outside of the time frame of the research activities. For instance, after completing workshops with our research partners, we were able to maintain a 'live' version of the document where attendees could add additional information after the activity or participants who were absent could also share their input.
We realized that due to issues of technological access and technology literacy, our sampling of participants may have been limited and biased by our activities being online. As mentioned, participants preferred to share ideas by various means - some sharing through virtual post-it notes, some speaking out loud or through the chat feature on the video conferencing application. We noticed it was difficult for them to do both at the same time. To compensate for this, we either had to allot more time for individual activities or scribe and take notes on the whiteboards while facilitating conversation, sharing similarities with others' experiences of additional researcher roles in online activities [11], [12]. As a result of varied levels of comfort, and various channels by which information was shared, we may also have faced an equivalent of a non-response bias, and our data may hence be biased towards the responses of some participants more than others. More so than usual, the research team had to remain vigilant to address any emerging challenges during the activities. Consistent with other researchers [11], we found ourselves using parallel channels such as text messages as a coordination 'back-channel'.
The participants' varying levels of comfort prompted us to try various tools. Expecting that participants might be more comfortable with common tools such as word processors and spreadsheets, we even adapted cloud-based versions of these to be shared whiteboard-like workspaces. This was only partially successful at addressing some of the drawbacks mentioned above. The spreadsheets added the advantages of direct organization of data for analysis in addition to digitization. Additionally, setting up formulae within the spreadsheet enabled the automatic copying of selective data across activities, facilitating continuity between individual activities. Yet, we noticed usability challenges of such a set up for some participants, similar to those experienced in prior research activities. Cloud-based word processing tools, while offering limited sophistication, were simple to use. We noticed a large proportion of participants use these easily and effectively as a shared workspace.

## 4 COMPARING THE SETTINGS

A comparison of the two settings and our experiences is summarized in Table 1. Our experiences of utilizing online collaborative tools are particularly focused on shared visual workspaces. We experienced using the tools in both the educational setting in graduate industrial design studio courses and in design research for healthcare systems. The differences in the two settings may have contributed to some of the variation in experiences noted above. Considering the characteristics of the participants, the students were relatively young, and we expect that being 'digital natives' they may be quick to adapt to the usage of such tools. Additionally, they may already have experienced using similar tools in other classes or projects. In comparison, we notice more of a variation of age ranges and comfort with technology across our research partners and stakeholders.

The frequency and duration of engagement may also play an important role. Since the students utilized the tools regularly over the course of their semester, they had the opportunity to refine their approach over time. Our research activities have been less frequent - once every few weeks or months; with some activities being one-off engagements. This may make it difficult for participants to adapt to the tools and processes and for us to adapt to the preferences and needs of the participants. Long term participatory research projects with more frequent interaction with stakeholders may have different, more productive experiences.

*Table 1. Comparison of using online workspaces in design education and design research*

| | Comparing the settings | Benefits of online workspaces | Challenges of online workspaces |
|---|---|---|---|
| **Design education** | - Students were younger and 'digital natives'<br>- Likely prior experiences with similar online tools<br>- Long, frequent activities | - Asynchronous feedback sharing<br>- Cross-peer learning<br>- Documenting and visualizing entire process | - Human connection negatively impacted<br>- Limited usage as repository in in-person or hybrid projects |
| **Design research** | - Participants had variability in age range and comfort with technology<br>- Unlikely prior experiences with similar online tools<br>- Short, infrequent activities | - Increasing access to geographically distant participants<br>- Enabling frequent engagement<br>- Collecting open- and close-ended data<br>- Asynchronous data collection and automatic digitization | - Participant ease of use dependent on comfort with technology<br>- Logistical issues and added researcher responsibilities<br>- Access to participants may be biased by technological literacy and access |

## 5 RECOMMENDATIONS

We find that like any human centred design process, the choice and tailoring of online participatory tools for education and research activities needs to consider multiple contextual factors. It is important to consider the people involved in the activities, and the nature of the activities and tools. We echo the approach of Lee et al. [8] and suggest that the affordances of the tools offer a useful additional perspective. Anticipating the synergy between the people, activities and tools can help educators and researchers tailor the activities and tools to be a good match for the people involved and research goals.

Regarding the people involved in the activities, it may be beneficial to inquire into their preferred modes of engagement prior to conducting the actual activity, such as during a pre-semester discussion for students or during a screening survey for research participants. Knowledge of what tools and technologies may already be used by the students or participants would also be beneficial. This can help choose tools that are most appropriate for the activities.

It is also important to critically assess the combined affordances of both the activities and the tools. For instance, if individual input in a shared visual workspace is needed prior to group discussion, the structure of the activity and the tool should promote this. The activity would need to allow for enough time for individual orientation and input. Considering the affordances of video conferencing tools, participants having time away from the video call, such as with cameras turned off while being in the larger group, may encourage meaningful individual contributions. On the other hand, if they are in a breakout room, participants may be used to engaging in discussion immediately. With the combined affordances of the video conferencing tool and shared visual workspace, participants can have a variety of ways to engage in activities. Regarding the need to enable participants to effectively express their

ideas without overloading facilitators during activities, organizers may benefit from a thoughtful balance of redundancy and constraints. Ideally there would be sufficient ways of sharing information for different types of participants while being a manageable process for facilitators.
We also suggest that organizers of such activities conduct pilot tests with the combination of tools that would be used in the final activities. Additionally, it would be helpful to provide pre-recorded or in-activity tutorials of how to use the tools involved. These measures would help to account for logistical issues such as logging in or creating accounts and getting acquainted with the tools, which may be especially relevant when dealing with multiple organizations or groups of stakeholders.
New online technologies and tools can facilitate remote collaboration in the spheres of design education and research. Continual consideration of people, activities, tools, and their associated affordances in combination can help us increasingly adapt for more effective educational and research experiences.

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