

## RECREATING THE EXPERIENCE OF AN IN-PERSON SUMMER INTERNSHIP PROGRAM REMOTELY

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We describe strategies, designs, tools, and technologies that were part of a 9-week experimental virtual summer internship program conducted during the novel coronavirus (COVID-19) pandemic. The goals for the program were to (1) recreate the in-person summer internship experience, (2) explore ways of getting people to help each other, and (3) develop a sense of community in a remote/virtual setting. We offer learnings gleaned by the team regarding building virtual communities that encourage collaboration and communication.

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### CONTEXT

The Tufts University Center for Engineering Education and Outreach (CEEEO) is dedicated to improving engineering education in classrooms from Kindergarten to college and works with various industry partners who are interested in the development of educational tools and technologies to support teacher communities and to funding educational research aimed at understanding how kids and adults learn engineering.

For the past 10 years, CEEEO has been employing 25-30 college interns to work on engineering, design, and research projects like integrating Image Processing and Machine Learning capabilities to existing LEGO robotics kits, designing low-cost robotics activities to teach programming to learners in developing countries, adding Augmented Reality visualizations to aid students' understanding of how different sensors work.

This year, novel coronavirus (COVID-19) forced us to redesign the in-person internship program, finding ways to simulate activities such as tinkering, design reviews, brainstorming and troubleshooting sessions, and coordinating the simultaneous and overlapping project development of more than 30 people and multiple strands of research and design.

### BACKGROUND

The COVID-19 pandemic has changed the current educational landscape, forcing the design of new ways to support learning in formal, informal, and virtual environments. Shifting to remote-only interactions required an adaptation of the perennial internship experience. Contending with the situation to recreate the in-person summer internship experience meant thinking about how to get team members to support each other and develop a sense of community in a virtual setting, like what we have achieved in-person in the past.

We soon realized that in addition to the adversities that the pandemic has brought forth, it has also highlighted new opportunities and affordances that only virtual tools and environments can offer. We have seen collaborators from

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different countries and different time zones work together to create a CAD model, we have noticed a night owl and an early bird working asynchronously to complete a common task, and we have observed excitement in kids from Nepal as they remotely controlled a robot halfway around the world in the US.

### **In-Person CEEO Internships**

In the past, when in-person for the summer, interns would typically work on hands-on engineering and design projects, building prototypes, testing, and iterating on their designs, and showcasing their progress to industry partners at the end of the summer program. Interns worked together at the CEEO office space from 9 am to 5 pm. They would share a common workspace, sit together, eat together, hack together, play frisbee together, and report to the faculty team leads 2-3 times a week. They would reach out to their peers or their managers if they ran into any issues or needed any feedback on their work. The graduate students or faculty members could easily look over the intern's shoulders if the interns struggled with an issue or they would grab a chair next to the person and look at the code together.

Likewise, for testing, parents would bring their kids into our space where the kids could interact with the prototypes our interns had designed and offer us valuable feedback. Towards the end of the summer internship program, 2-3 representatives from the funding organizations would visit our space and interact with our interns, play with their prototypes, and ask questions about their projects. Playing frisbee, having lunch together, joking around, and getting to know each other through small talks and hallway conversations provided opportunities for everyone to become friends and foster a sense of belonging to the CEEO community.

### **Summer 2020 Experience**

Like the previous years, we opened the summer internship applications in early January and most of the interns were accepted to the program by mid-March. We had funding available to hire the students, and the leadership team had a list of projects they were eager for interns to work on. However, typically, we would only start planning out the details of the summer internship program after the Spring semester ended. Further, even though we discussed the possibility of the summer internship being affected by COVID-19 in our weekly leadership meetings, we remained hopeful as late as April that the internship program would still be in-person. Unfortunately, we had not anticipated the extent to which COVID-19 would force us to reimagine the in-person summer internship experience as a "remote internship."

In the last week of April, we started collaborating on a Google Document as we brainstormed considerations for the remote internships, including (i) materials the interns

would need throughout the internship which we would have to gather and ship at the beginning of summer, (ii) questions to ask the interns about their home setups and needs for them to be able to participate and contribute to the various research strands, (iii) activities and related materials that might foster collaborative group experiences, (iv) tools, applications and setups that might aid students documentation as they kept track of their work, (v) pre-orientation skills that would help the interns immediately engage with the projects, and (vi) fun sessions, ice-breakers, and team building activities for everyone to get to know each other and the CEEO community.

The following week, we created a summer team leads channel on Slack that included 10 members—Tufts faculty members, graduate students, postdocs, and staff, who would be responsible for different aspects of the summer internship program. In addition to this model of distributed and cascading leadership where different team leads oversaw a particular research strand and were responsible for managing and mentoring a group of interns, we assigned a dedicated role of a coordinator (taken by the first author) to make sure that we were meeting the following goals:

1. The student interns are pleased with the summer experience and want to continue working with us,
2. The team leads come away with a feeling that their research is advancing, and
3. The industry funders are pleased with the progress and continue funding us in the future.

By May, it was clear that the entire summer would be virtual, and we decided to experiment and use the summer experience to inform our teaching practice in the upcoming Fall semester in which most of the courses the faculty members were teaching would be remote.

At the CEEO, we have a long history of summer internships being very successful because interns would continue their projects at the CEEO during the academic year, the team leads would advance their research, and industry partners continued to report satisfaction in the outcomes of the summer internship work. So, this year as well, we were confident that our team's willingness to experiment, try new software platforms, and push technological boundaries would help us adapt to the unanticipated situation and help us meet the set goals.

Further, since we had hired the interns before the pandemic and we already had funding from our industry partners, we decided to recreate the in-person summer internship experience virtually/remotely.

Towards the end of May, in addition to the interns who had applied for the job in January, we increased the number of hires to accommodate students who needed a summer job because a lot of other internship opportunities were

canceled due to COVID-19, with the assumption that we would figure things out as we moved along.

This year, we had 25 interns—5 high school students and 20 Tufts students, undergraduates as well as recent graduates who worked on 8 different research strands. Although some of the elements of the in-person experience were missing this year, we leveraged past experiences and tried to recreate events and activities that had worked well in the previous years.

## EXPERIENCE DESIGN

In this design case, we attempted to recreate the in-person summer internship experience, finding ways to simulate activities such as tinkering, design reviews, brainstorming and troubleshooting sessions, and coordinating the simultaneous and overlapping project development of more than 30 people and multiple strands of research and design. We had three main goals for the project: (1) to recreate the in-person summer internship experience for the CEEO interns virtually, (2) to explore how we can get people to help each other remotely, and (3) to develop a sense of community in a remote/virtual setting.

### Early Stages of Design & Challenges

The summer leadership team that consisted of 2 faculty members, 1 postdoc, 3 Ph.D. students, 2 Master's students, and 2 staff members were responsible for the early stages of design of the summer experience. Starting from May, we met weekly to brainstorm ideas, discuss challenges, build research-specific deliverables for the end of the summer, set clear milestones, and schedule regular check-ins with our industry partners.

In addition to the weekly meetings, we asynchronously updated ideas on a shared Google document, and leveraged the #summer\_team\_leads channel on Slack to share ideas about activities, tools, strategies, and technologies that might help us recreate the various elements of past summer internship experiences.

Decisions about selecting some tools like Zoom and Slack were straightforward and turned out to be very successful throughout the summer. For instance, we used Zoom for our weekly meetings because students already had experience taking online classes on Zoom, and Tufts provided students access to Zoom paid accounts. Likewise, for Slack, it was free, we had been using it to communicate with each other since the pandemic had forced us to work remotely, and we had previously relied on Slack even in the 2019 in-person summer internship.

Decisions about other tools were harder to make and did not necessarily turn out to be as successful as we had anticipated. For instance, we spent a significant amount

of time deciding on a task management tool because we assumed that it would be difficult to track student progress in a remote internship program. To prepare for this possible issue, we constantly updated a Google document where we listed various tools such as Google Sheets, Coda, Teamwork, Airtable, Canvas, Google Classroom, Jira, Trello, Asana, Basecamp, Planner, Sunsama, Monday, Pivotal, Microsoft Planner, and Notion, along with their salient features, strengths, and weaknesses.

To narrow down the choices, we decided to test some of the tools in smaller teams. Three team leads used Asana for a week updating their weekly/daily task list on the web application. Likewise, since the CEEO team members had access to a paid subscription of Teamwork, the summer coordinator tested it for a couple of days. In addition to our personal preferences and experience using the tools, we also reached out to our friends and colleagues who had been managing remote software development teams and we maintained an active discussion thread on our Slack channel.

We did not select Trello because a team lead pointed out that "Trello is cute but not very powerful for anything beyond the superficial." We gave up on Teamwork because we thought "the interface might be overwhelming for beginners." Similarly, there was a "consensus that Jira (was) not a favorite" because it was "too complex". Ultimately, we selected Asana because it was free and could be easily integrated with Slack.

Likewise, in the early stages of design, we had high hopes for Miro. Recognizing the potential of building a virtual community in Miro, we integrated everything on a single board and encouraged everyone to populate it. The common Miro board had a list of team members, their virtual introductions along with headshots, a calendar, links to recurring Zoom meetings, and group division charts for various activities. In the first week of the internship, we added more information on Miro such as links to personal Zoom rooms, links to Google sites, a gallery space to share pictures of fun activities or events, a notice board to post announcements and recruit volunteers, and even team-specific task management boards. These numerous additions made the board cluttered and reduced the tool's performance.

Even though we were purposeful in selecting some of the tools and designing activities around them, we were also aware that our preconceived notions about the potential success of the tools, platforms, or technologies were not always accurate. So, we wanted to experiment with different tools and observe what would naturally surface. Interestingly, Miro did not fare as well as we had hoped, and instead, an integration of Slack and Google Calendar turned out to be the team's favorite.

Two other interesting issues played a large role in the summer success. First, even though we had set up a system

to allow the interns to make custom online order requests and arrange for the purchased items to be mailed directly to their homes, shipments were usually delayed. This summer, it was taking up to 10 days longer for the deliveries to arrive in comparison to overnight shipping in previous years. Second, the Tufts internal paperwork slowed way down, meaning that new hires were not getting paid at the start of the summer.

### Tools & Applications

Tucker-Raymond and Gravel (2019) identify 5 STEM literacy practices:

1. Identifying, organizing, and integrating information across sources.
2. Creating representational forms and traversing representational systems.
3. Communicating with others for help and feedback.
4. Sharing finished or almost finished objects
5. Documenting making processes and/or milestones.

We took into consideration these STEM literacy practices when selecting the different tools for the summer internship program because the CEEO operates more like a makerspace than a traditional workspace because the interns undertake making/engineering/building projects.

**Zoom**—a video conferencing software widely used in educational spaces, thus familiar and accessible for the interns and useful to ask for help or feedback.

**Slack**—a collaboration hub and messaging platform which could be leveraged not just to communicate with each other but also to share progress on your projects.

**Miro**—an online collaborative platform that enables teams to brainstorm ideas, thus useful to create visual representations and organize information.

**Gather.town**—a video conferencing platform (suggested first by an intern) that enables gatherings in virtual spaces which simulates a real-world communication scenario where you need to walk up to a person to start a conversation.

**Microsoft Teams**—a unified communication and collaboration platform that combines chat, video meetings, file storage, and app integration, as an alternative to Zoom.

**Asana**—a task management tool that helps teams organize, track, and manage their work to keep track of multiple strands of research and delegate tasks.

**G Suite applications**—a suite of cloud computing, productivity and collaboration tools, software and products developed by Google, which are useful to organize and integrate information across sources.

Vygotsky (1981) proposed that learners' engagement with ideas are mediated by "cultural" and "psychological" tools which suggests that people make sense of ideas through production and engagement with different kinds of artifacts—representations, objects, or language—that have "been modified over the history of its incorporation into goal-directed human action," (Cole, 1998, p. 117). Hence, representational tools are central to learning. We build on this idea to think about the role of representations in the context of a virtual internship experience because we rely on non-verbal representations such as text, sketches, or emojis to communicate and learn.

Each week we experimented with different tools and platforms to design activities to simulate aspects of the in-person summer internship experience to recreate a similar experience for the new interns working remotely/virtually. For example, to start building the community, we asked the interns to virtually introduce themselves on Miro by asking each member to post a picture and answer a few questions about themselves. This simple act of participating in a common activity developed a sense of familiarity amongst the team members even before the interns were assigned to their respective projects. Likewise, to encourage collaboration among interns working in different teams, we created a virtual CEEO workspace on Gather.town which allowed the interns to hang out in the virtual space and have informal conversations with their peers—something which was very common in the in-person internship experience in the previous years and was possible because of the tool's feature that simulated a real-world conversation scenario.

IN-PERSON	REMOTE/VIRTUAL
Friday Frisbee	Virtual CEEO fun time
9 am daily stand-up meetings	Zoom check-ins, Asana boards
Hackathons	Virtual hackathons
Guest speaker series	Zoom seminars
Orientation	Virtual introductions on Miro, Zoom events
Informal conversations	Zoom meetings, #random channel on Slack
Lunchtime	#food channel on Slack
Final showcase	Virtual showcase
Feedback	Weekly Google Forms survey, reflections on Miro
Debugging	#issues channel on Slack, remote control on Zoom
Physical builds	Ship LEGO sets to the interns

**TABLE 1.** Comparison of in-person activities with remote/virtual activities.

Because our tool choice was not always a good one, we actively experimented with other tools throughout the summer internship program and involved students in suggesting, experimenting, redesigning, and deciding on the tools and strategies. For example, Gather.town was suggested by one of the interns in a feedback session and to explore how it could be used, another intern created a virtual map of the CEEO space. Once we had the map ready, we tested a “gallery walk” style sharing structure and received feedback from the interns to refine it.

### Events & Activities

See Table 1 for a listing of various events and activities we aimed to recreate at the start of the summer internship program, implementing the various tools.

### Themes

As the summer internship progressed, we noticed the events and activities could be categorized into the following themes:

1. Community Building
2. Communication
3. Collaboration
4. Planning/Organizing
5. Feedback

We present these themes, and the different events and activities that comprised each theme, by first introducing the need for the activities, followed by the specific tools selected, iterations on the designed environment, and finally outcomes and perceptions shared by the interns in interviews and end of summer surveys.

## COMMUNITY BUILDING

In previous years playing frisbee, having lunch together, joking around, and getting to know each other through informal discussions and hallway conversations provided opportunities to build community. This summer we had to get creative and leverage the available tools to recreate those experiences.

To start building the community, we asked the interns to virtually introduce themselves on Miro by asking everyone to post a picture and answer a few questions about themselves. We noticed that this simple act of participating in a common activity developed a sense of familiarity amongst the team members even before the interns were assigned to their respective projects. Further, the interns got to learn



**FIGURE 1.** Example Miro board where team members introduced themselves virtually.

about the larger structure of the CEEO and how the different projects were connected.

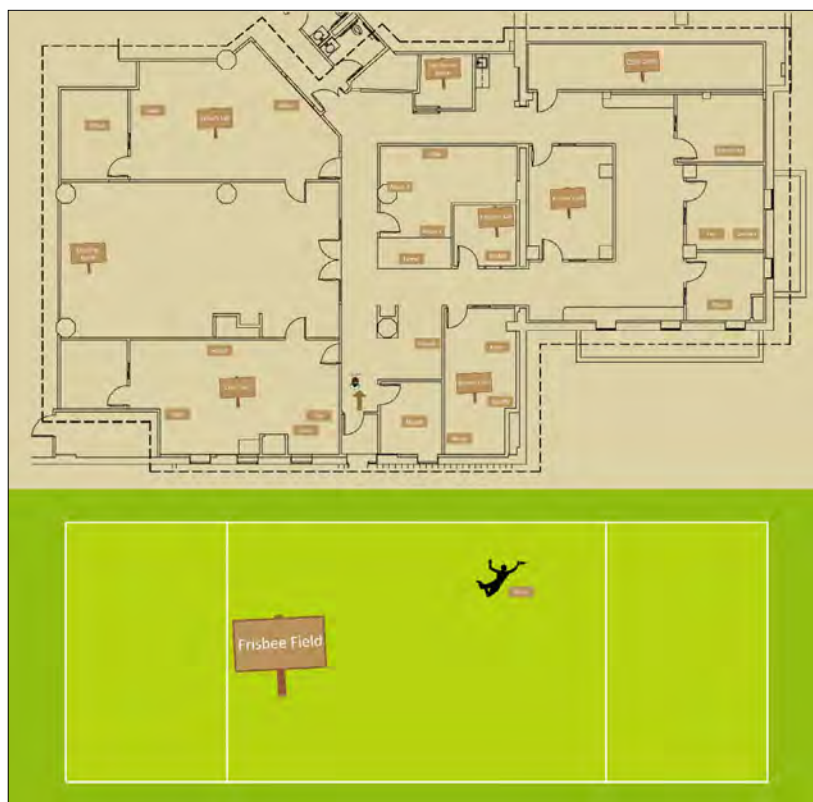
As a result of experimenting at the end of spring semester, we found that students enjoyed hearing from practicing engineers—both what they are doing and how they got there. So, we decided to organize a weekly Speaker Series. As an early experiment, we confirmed 3 speakers for the first two weeks after which we asked the students for their feedback about the sessions. We were surprised to learn that the students asked for the speaker seminars to be held twice a week which was in stark contrast to complaints that most graduate students had about attending weekly seminars which is a requirement for most departments. Additionally, it is also important to note that although these seminars were voluntary, on average 30 participants attended these sessions (based on attendance data collected from Zoom).

It was clear that the students enjoyed hearing from the guest speakers and appreciated learning about their career trajectories. A student messaged us on Slack saying, “It’s super hard to show appreciation and emotion through Zoom, so if you could please pass on my gratitude to her for me and let her know that I very much enjoyed learning about her and her partner’s art pieces and exhibits and the messages they’re meant to portray to the audience.” We passed along the message, but we were left wondering about the limitations

of virtual platforms to “convey emotions” because we had been struggling with encouraging students to ask questions and involving everyone in a discussion. Further, since the interactions were virtual it was difficult for the speaker to get a sense of how their talk was going or if the audience was engaged. Based on such observations and feedback we received from the interns, we suggested a new 45-minute format: presentation by the speaker (10 min), breakout room discussions (10 min), and Q&A session (15 min), for the new speakers which turned out to be quite effective. In addition to that, we also learned a lot from the different strategies the speakers used in their talks. For example, two guest speakers utilized Polls Everywhere to engage the audience and to encourage them to participate in the discussion. Similarly, another guest used Google Documents to facilitate a collaborative reflection activity.

We tried one completely new experiment on June 19, where the students were encouraged to attend the “Juneteenth: Day of Reflection, Commitment, and Action” event organized by various organizations at Tufts. Although this was something we had not planned at the beginning, considering the relevance of issues related to systemic racism, interested members formed a committee and led an initiative to discuss ideas around race, diversity, and inclusion in a weekly Systemic Racism Conversation Block. The members of the committee leveraged tools such as Google Documents to collect anonymous suggestions from the participants and Zoom breakout rooms to hold small group discussions. The interns appreciated that their voices were being heard as one intern mentioned “...even if we were just interns, we were able to give feedback to the whole CEEO and made me feel like I was contributing to the CEEO as a whole.”

In the previous years, Friday frisbees used to be a common time for everyone to get to know each other outside the workspace. We wanted to create similar opportunities where interns could get to know people in an informal setting. Two team leads formed the “fun committee” and planned fun collaborative virtual events for the team members (with one intern joining the fun committee two weeks into the summer). CEEO Fun-time included games such as Drawasaurus, Codenames, and Drawphone and on average had an attendance of 18 participants (based on attendance data collected from Zoom). The interns “felt like that (CEEo Fun-time) was a really good outlet. I guess a little break from work, and I think even though it was remote, it was definitely a time for everybody to sort of get together.”



**FIGURE 2.** Virtual CEEO workspace created on Gather.town.

At the start of the internship, we wanted to recreate informal spaces that would provide opportunities to get to know each other through small talks and informal conversations. Although we had thought about the idea of a virtual space, we had not really explored other options. We mostly relied on #random channel for interns to share fun ideas or memes. In a brainstorming session led by one of the guest speakers where the participants were thinking about making science and engineering learning engaging for middle schoolers, one of the interns suggested a tool called Gather.town. One of the team leads really liked the idea and decided to test it with her team of 2 interns. Their team selected a “office” map and used the virtual space to hold meetings for the entire day. They were impressed by the tool and recommended it to other teams. Another team lead explored the customization features on Gather.town and recognizing the tool’s potential to recreate hallway conversations asked an intern to recreate the CEEO space virtually. Hearing about this idea, the administrative staff member emailed the intern a pdf of the CEEO floor plan which he (the intern) then used to recreate the space. He even added a secret pathway to a secret room and created a virtual Frisbee field for team members who missed the activity. It was great to see members from different teams collaborate to build the virtual CEEO space.

Since we had the virtual space available, we further experimented with the tool to hold a virtual Hackathon, we

created another custom map to recreate a “Gallery walk” style sharing session, and we held a “speed dating” style getting to know each other activity during CEEO Fun-time. Gather.town worked out well for informal conversations but for day-to-day use, most interns and team leads preferred Zoom because of better video/audio quality and smoother screen sharing features. In Gather.town, there was also a pervasive uncomfortable feeling of “eavesdropping” as you walked by an ongoing conversation.

As the summer progressed, some of the interns mentioned that they knew what their team members were working on, but they did not have any idea about what other teams were doing. So, to address this issue and encourage cross-team collaborations, we introduced a new structure for each team to post a 3-minute update video about their project on a dedicated Slack channel and for the other teams to offer feedback on their work and to share ideas about possible collaborations. One update video a day would be posted, implying that each group made three over the course of the summer. This was an interesting approach to asynchronously get updated on progress across different research strands. According to one of the team leads, this sharing format made her team’s “work visible to the rest of the teams” and the reactions and comments on the video made her team feel appreciated and their work valued.

### Tool Rankings

After the end of the summer internship, we asked the consenting participants to fill out an online survey in which 10 interns and 4 team leads participated. We asked the participants to rank the different tools we had used during the summer based on how well they enabled Collaboration, Communication, Planning/Organizing, Feedback, and Community Building.

Analyzing these data proved somewhat challenging. In Figure 3, one can see our first attempt at analyzing the ranking data (rank of 1 is best), but as it is evident from the chart, the data presented with granularity this fine hid the trends and made it difficult to see how participants responded to different tools for different themes. Combining the ranking occurrences into 3 categories, akin to a coarser grain Likert scale: 1-2, 3-5, and 6-7, better illuminated the participants’ perceptions of different tools’ utility for each of the themes.

For example, from Figure 3, we can see that for Slack (orange dots), there were four participants who ranked it as #1 and five participants who ranked it as #2. So, Slack’s combined ranking in the range 1-2 was nine, as indicated by the blue bar in Figure 4. This gave us a more salient view of the data and shed light into some interesting patterns relating to participants’ perceptions. We used this technique to describe rankings for each of the themes.

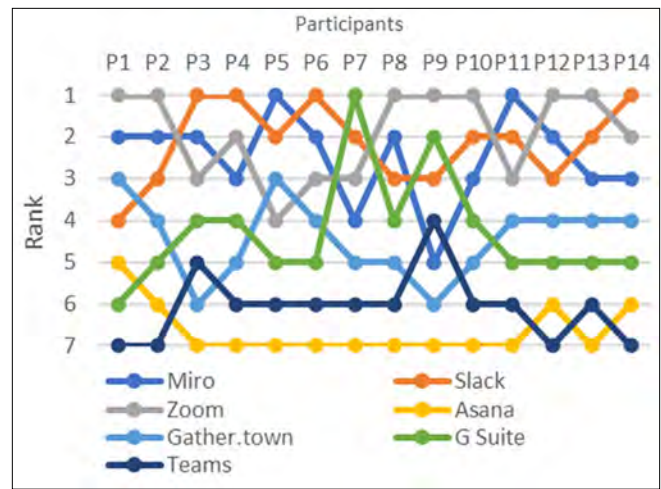


FIGURE 3. Ranking of tools based on how they enabled Community Building (1st attempt).

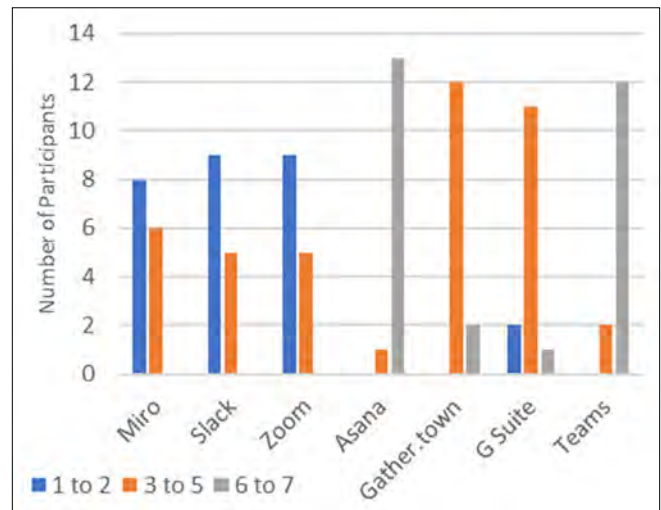


FIGURE 4. Ranking of tools based on how they enabled Community Building (2nd attempt).

It is evident from Figure 4 that Slack, Zoom, and Miro were the tools most participants felt best supported community building. In the interviews as well as the survey, the participants mentioned features such as breakout rooms (Zoom), interest-specific channels (Slack), and virtual introduction board (Miro), contributed to enabling community building.

Gather.town was ranked moderately in comparison to other tools. One possible reason for it might have been some negative experiences like unstable audio/video connection or inability to communicate with everyone at the same time using the free version.

## COLLABORATION

In previous years, we set up the workspace environment so that opportunities for collaboration would surface naturally. The team members would work together, eat together,

and hack together—which naturally led to cross-team collaborations.

This year, we struggled to recreate similar opportunities for cross collaboration. The previously mentioned 3-minute video update was a success in fostering some crosstalk and a few cross-team collaborations. For instance, the Web Development team approached the Multimedia team to collaborate on a website banner design after watching their video update. Unfortunately, these collaborations were limited, and we hope to address this issue in the next iteration of design.

Also, in previous years, the graduate students or faculty members could easily look over the intern's shoulders if they were struggling with an issue or could grab a chair next to the person and look at the code together. We leveraged Zoom's "screen share" and "remote control" feature to debug codes and resolve similar issues. Another successful approach that the interns utilized to ask for help or feedback was the #issues channel on Slack. As shown in Figure 5, the students would capture a screenshot of their code and ask for advice from other team members. It usually took only a couple of minutes for other interns or team leads to respond to the issue and a couple more minutes to resolve it. Likewise, interns also used Zoom's "screen share," and "remote control" feature to do peer-coding.

Further, different team members utilized different strategies to test their ideas and receive feedback on their work. One team lead utilized different shapes in Miro to recreate the testing environment for a paper-based programming tool where two participants collaborated to build a program sequence. The Placemats team organized a Hackathon and paired members from different teams to build LEGO structures and the Online Learning team tested a robotics curriculum and code examples by sharing the content on GitHub.

Likewise, some session facilitators needed to divide the participants into different teams, either randomly or based on certain criteria like familiarity with a software or comfort level with a tool. It was useful to ask participants to self-select into groups based on their expertise or comfort level, or whether someone was on a Mac or a PC, or whether someone had a LEGO EV3 or a SPIKE Prime set. The facilitators leveraged Miro's capabilities to quickly rearrange "sticky notes" to help them form teams and assign collaborative tasks. Here is an example of how they organized the participants into teams based on their levels of expertise.

### Tool Rankings

In Figure 7 we can see that Zoom, Slack, and G Suite were ranked in the top range by most participants. In the interviews as well as the survey, the participants mentioned



FIGURE 5. Jim asking for help on Slack's #issues channel.

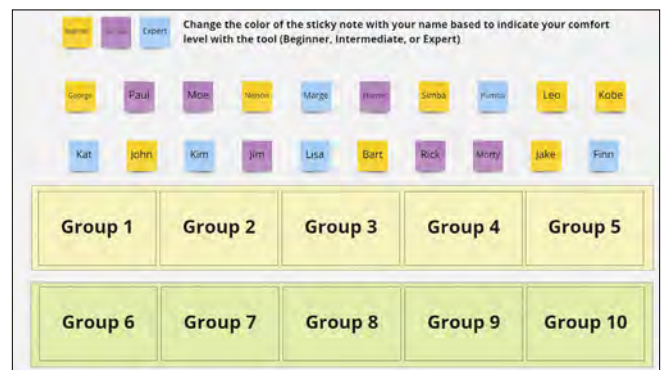


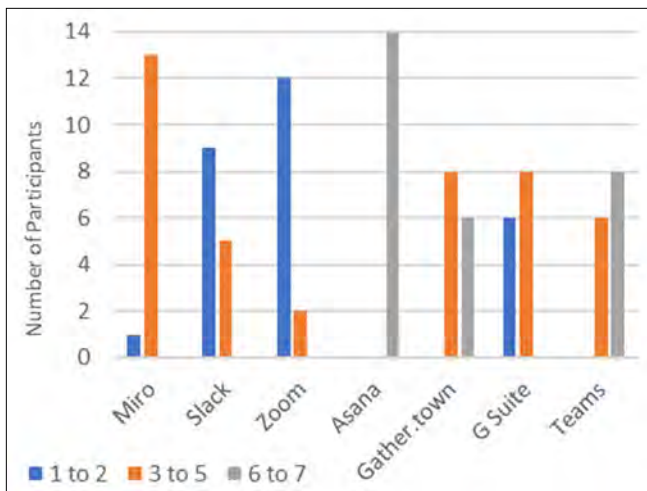
FIGURE 6. Example Miro board for team division.

features like breakout rooms (Zoom), "screen share/ remote control" was also super helpful to sharing information and debugging" (Zoom), "working together in real time" (G Suite), "making groups to send direct messages" (Slack), and "sharing link with anyone" (G Suite), contributed to enabling collaboration. We found a few key integrations as well. We struggled initially with time zones but integrating Google Calendar into Slack provided the appropriate reminders. We also leveraged the "Info" field in Slack to share Zoom addresses, making it easier to quickly start a video-based conversation.

## COMMUNICATION

In the in-person internship experience, it was easy to communicate with each other because everyone was in the same physical space. This year, we tried to simulate some aspects of the in-person interactions using online tools. The preferred tool for one-on-one conversations as well as group conversations was Slack because team members could easily send a message and get instant responses. Most teams decided on a daily check-in meeting with their team leads to



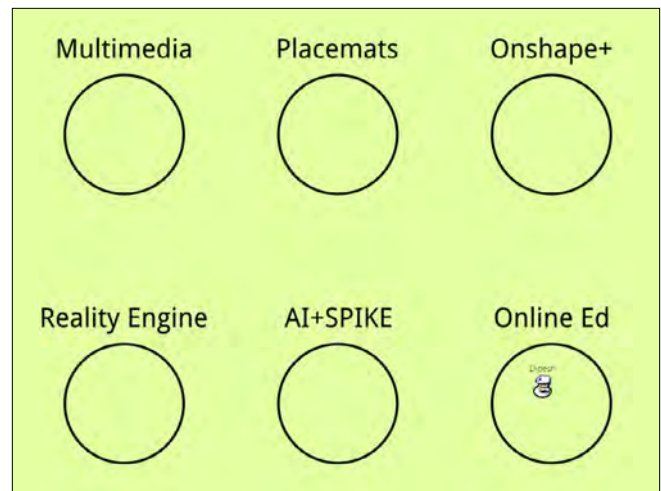


**FIGURE 7.** Ranking of tools based on how they enabled Collaboration.

update their team members about their work and keep track of their progress.

Also, in previous years, faculty members would go around the different workstations and get updated on what everyone was working on. We wanted to simulate a similar sharing structure in a virtual environment. First, we experimented with a Gallery walk style sharing setup using the virtual CEEO map. The participants did not enjoy the experience because of the tool's limitations—the audio/video quality was not as good as Zoom, the characters had to be very close to each other to be able to hear each other clearly, there was no way to communicate with everyone at once, and it was difficult to keep locate the different groups because the virtual space was quite spread out. In the next iteration, we simplified the custom space by designing circular pods for the respective teams. We experimented with the perimeter of the circle, so that members who fit inside the circle would be able to hear each other well but at the same time, the spacing between the two circles were far enough that the other teams would not be able to hear the conversation. The simpler design worked well once the participants had clear directions about when to stay in their circles and when to move to the other group.

Similarly, in previous years, 2-3 guests from our industry partners would visit us at the end of the summer to hear from the interns about their projects and the progress that was made. The guests would interact with the interns, ask plenty of questions, and watch live demonstrations, and play with the physical products and prototypes. Since everything was virtual this year, we had to think creatively about how we could replicate some of the elements of interactions and engagement that the in-person sharing offered. Fortunately, we also saw opportunities in everything being virtual



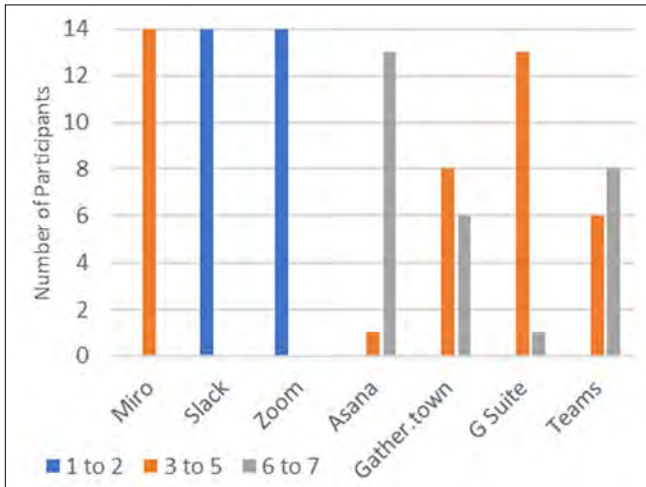
**FIGURE 8.** Custom space in Gather.town to recreate a gallery walk setting.

because we could invite a lot more guests from industry partners because they could join us virtually.

In our first attempt, we figured a pdf flyer would suffice to communicate to our guests about the progress happening across all different research strands. So, our design intern created a fun flyer design. After an internal design review, most members pointed out that the information on the single page flyer was not enough to clearly communicate the essence of the projects. So, we decided to add a link to a Google Document on the flyer so that the guests could learn more about the projects, if they were interested. In the second iteration, different teams started populating a common Google Document with pictures and texts explaining their projects. But soon, the document started looking messy because different teams were using different styles and formats. In the third iteration, we decided to provide a Google Slides template for the teams to update their information to maintain design consistency. Satisfied with our design, we distributed it to the industry point people for feedback. They liked how the slides were set up and gave us valuable feedback about organizing the information on the slides to add clarity. In the fourth iteration, our slide deck had 3 sections: a 2-minute video pitch, details about the project (learning objective, key users, project maturity, phase of testing), and space for questions about the projects that the guests could update asynchronously. Distributing this pre-read slide deck turned out to be an effective solution to get the guests updated on the different projects, leaving more time for the interns to answer questions from the guest and for the guest to interact with the projects when they joined the synchronous virtual gathering. In the end, we split the industry visitors into two groups with each group only seeing 1/2 of the talks (5 out of the 10 projects) but therefore having more time for questions and discussion. The sponsors were pleased with the final discussions and student work.

## Tool Rankings

In Figure 9, we can see that Zoom and Slack were ranked in the top range by most participants. The participants mentioned features like “being able to DM people if I had questions” (Slack), “create group chats” (Slack), “instantaneous feedback and being able to see my teammates” (Zoom), contributed to enabling communication.



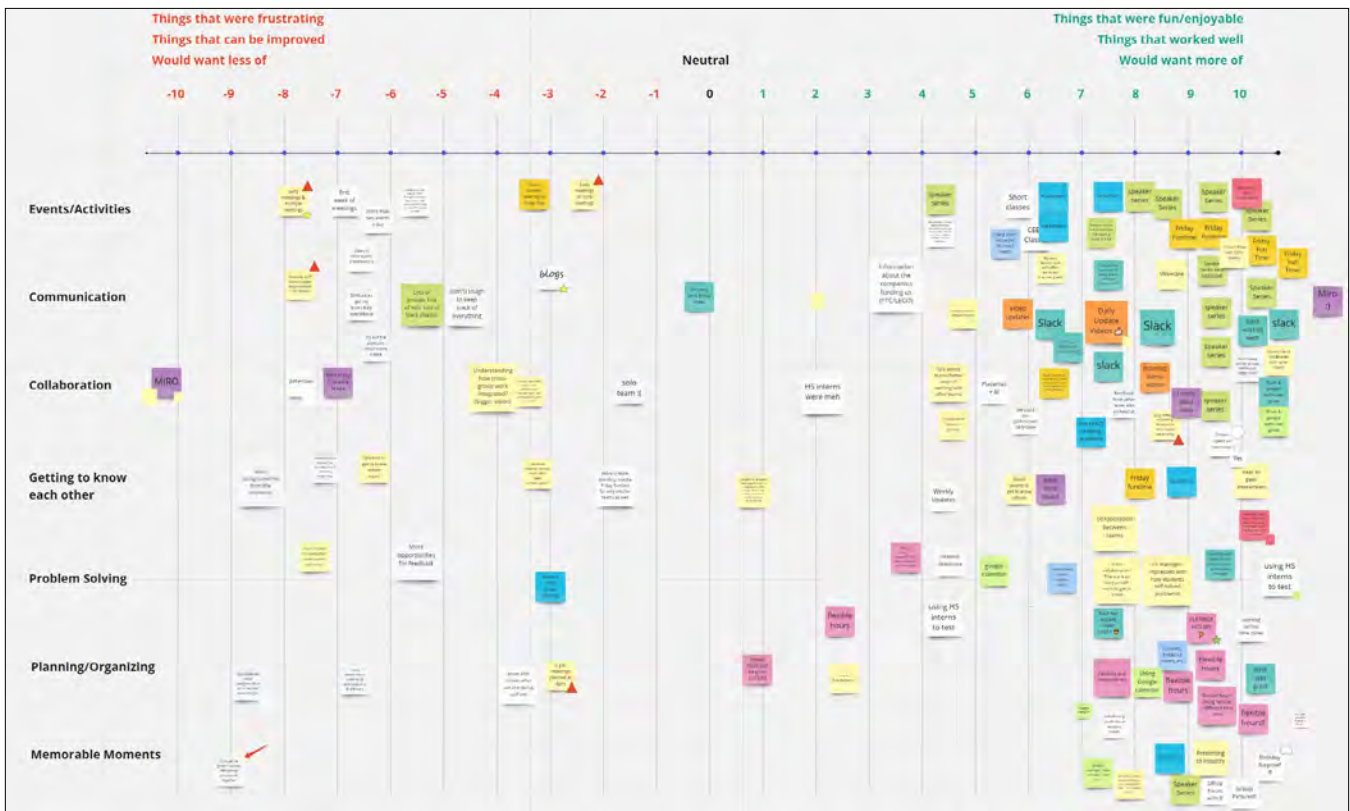
**FIGURE 9.** Ranking of tools based on how they enabled Communication.

## FEEDBACK

In previous years it was relatively easy to gather people around the table and ask for their feedback but this summer we had to leverage tools like Miro, Slack, Google Forms, and Google Documents to offer and receive feedback.

To get a sense of how the summer experience was going and get feedback on what was working and what could be improved, we asked the interns to fill out a weekly anonymous Google Form survey. Each week, the summer internship coordinator went through the responses and shared any interesting insights to the rest of the leadership team on the weekly meetings. The survey responses helped us to make necessary changes in case anything was not working and to integrate useful suggestions from the interns. The interns’ suggestions helped us iterate on our strategies for communication and collaboration.

In the past, at the end of the internship, we would gather the interns in the CEO workshop room and ask them to reflect on how their summer internship experience was. This year, for the end of summer reflections, instead of asking everyone on a Zoom call to share their thoughts about their summer experience, we first wanted everyone to fill out a reflections board on Miro silently, and then ask the interns to share their thoughts.



**FIGURE 10.** End of summer reflections on Miro.

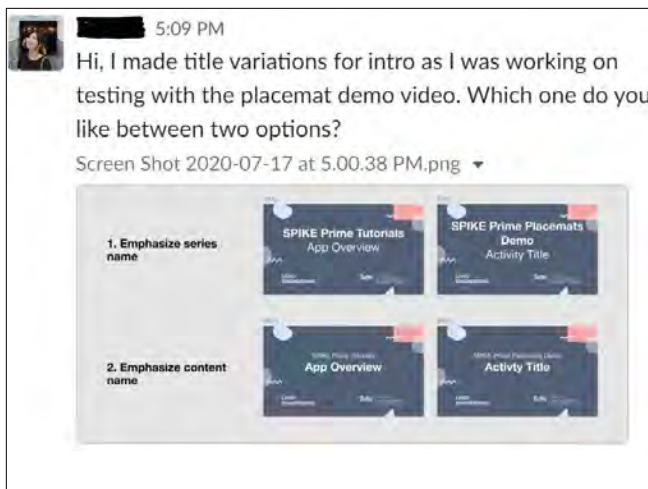


FIGURE 11. Kat asking for design feedback on Slack.

The Miro board gave us valuable insights into what activities the interns enjoyed and where there were rooms for improvement for our team. For starters, we were glad to see a lot more “sticky notes” on the positive side of the board, but it also showed us which activities the interns valued and what tools they used the most. For instance, a lot of the interns mentioned the Speaker Series, CEEO Fun-time, and Systemic Racism Conversation Block multiple times, indicating their popularity. This also highlights the importance of organizing non work-related sessions and activities to build virtual communities. Likewise, the interns also mentioned tools like Slack, Zoom, Miro, and G Suite multiple times. The popularity of Slack on this reflection board is also consistent with the data from tool rankings chart. One interesting realization we had when the interns were filling out the reflection board was that it was clear that some interns really liked Miro while other interns did not. This might explain why Miro collaborations did not materialize as well as we had hoped.

Further, some teams also used Slack to get feedback on design. They would share multiple design options and ask the other members to use the poll feature on Slack or their favorite emojis to indicate their preferences. This turned out to be a quick and easy way to choose the best design option. Further, some of the team members mentioned that they liked Slack because the feedback they received would be saved and they could search for it later in case there was any confusion. In this sense, some members were also using Slack as a note-taking tool to document feedback on their work.

### Tool Rankings

In Figure 12, we can see that Zoom and Slack were ranked in the top range by most participants. The participants mentioned features like “instantaneous feedback and being able to see my teammates” (Zoom), and ability to post images or video to ask for feedback (Slack), contributed to enabling feedback.

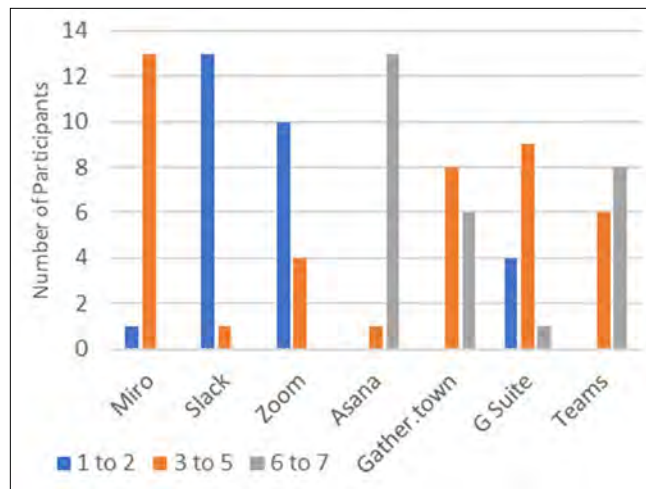


FIGURE 12. Ranking of tools based on how they enabled Feedback.

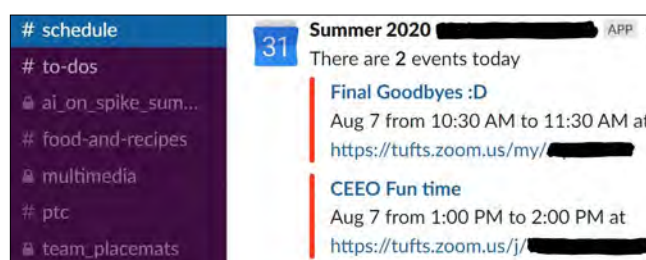


FIGURE 13. Integration of Google Calendar on Slack.

## PLANNING/ORGANIZING

In past years, each day would start with a 9 am whole team stand-up meeting where each team member would share what they were working on. Additionally, since we had interns working in different time zones, we needed to come up with alternatives that would work for everyone.

Since we had designed everything around Miro, the Miro board had recurring Zoom meeting links, links to personal Zoom rooms, task management boards, and a whole bunch of other stuff. Unfortunately, most of the interns mentioned in their weekly feedback surveys that they had difficulty finding relevant information and they had to ask their peers to make sure they were not missing any meetings. So, we investigated other alternatives and ultimately integrating Google Calendar for Teams on Slack turned out to be quite effective. This integration would not just remind everyone to join group meetings but would also provide a Zoom link to the meeting.

Similarly, adding links to personal Zoom meeting rooms, Google Sites, and GitHub repositories, on the Slack profile reduced distribution of information across different platforms and Slack turned out to be a central communication platform.

In the interviews, two interns mentioned that they sent direct messages to themselves to keep track of their work

and to remind themselves of what was on their plate for the week. One intern mentioned that she relied on a physical notebook to create a task list because she was used to that. Another intern had a similar strategy to organize her work, but she used the sticky notes on Miro to create a task list. So, in general, different people had different preferences and strategies to organize their work. Likewise, some teams continued the previous year's tradition of daily 9 am stand-up meetings while others who had members from different time zones did the stand-up meetings at 3 pm. In addition to the internal check-ins, we had also scheduled three industry check-ins spread out across the 9-week internship which helped the teams keep track of their milestones.

### Tool Rankings

In Figure 14, we can see that Slack, Zoom, and Miro were ranked in the top range by most participants. The participants mentioned features like “integration of Google calendar” (Slack), “organize to-do lists” (Miro), and “plan update videos” (Zoom), contributed to enabling planning/organizing.

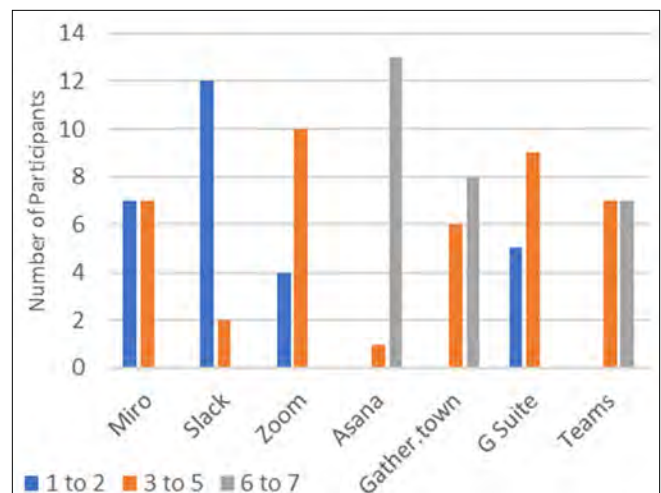
As we mentioned in the “early stages of design” section of this paper, we spent a significant amount of time and energy to decide on a task management tool and that even though we were purposeful in selecting some of the tools and designing activities around them, we were also aware that our preconceived notions about what tools/platforms/technologies work best are not always accurate. Asana's ranking in the Planning/Organizing category, even though it is a task management tool, reiterates that message. One possible reason for Asana being ranked in the lower range is that not all teams implemented it. And for the few teams who experimented with it, daily update meetings with team leads, regular check-ins with industry partners, and use of other tools like a physical notebook, Slack, and Miro negated the need for a dedicated task management tool.

## LEARNINGS

Based on our experience running the 9-week summer internship program, analysis of data, and reflection on our design, we want to share some learnings derived from our experimentation and observations.

### Provide opportunities for team members to get to know each other outside of a formal environment.

The virtual environment does not immediately recreate the kinds of personal and informal interactions that come with sharing space with others. Meetings and events are scheduled, communication is goal-driven and specific, and the opportunities to just be with and around others can be lost. However, we worked to create space and opportunities for team members to build relationships with each other both through the work and outside it.



**FIGURE 14.** Ranking of tools based on how they enabled Planning/Organizing.

Referring to the end of summer reflections as well as interview responses, the interns appreciated opportunities to get to know each other through activities like CEEO fun time, systemic racism conversation blocks, and sharing common interests or silly memes in the #random Slack channels.

### Explore creative ways of leveraging existing technology to replicate in-person experiences.

At the start of the summer, we certainly had doubts about how the summer internship program would turn out to be and we had no idea whether we would be able to recreate the in-person internship experience. Instead of calling the whole thing off, we thought about creative ways to leverage existing technology to replicate some in-person experiences.

For example, by combining different strategies like distributing pre-read slides before the final showcase, engaging the audience in a scavenger hunt to explore a new website design, using Zoom's remote-control feature to control each other's screen, and controlling a robot using a web app, we were able to engage over 40 guests in the final showcase.

### Provide multiple options to facilitate communication and collaboration.

As evident in the tool ranking charts for the different themes, there is no clear consensus around the best tool for a particular task. This should not come as a surprise, as people have different preferences that influence the ways they engage in and use different tools. Given different people have different relationships to tools and ways of integrating them into their practices in individual ways, we should provide options in terms of different tools to support similar kinds of work.

For example, some people might be comfortable asking questions on a group Zoom call while others might be more comfortable sending a direct message via Slack.

### **Add physical elements to enhance the virtual experience.**

Although majority of the interactions in our summer internship program were virtual, we tried to add in physical elements to enhance the virtual experience. For example, we introduced a 10-minute stretching routine before starting a long Zoom conversation which made everyone get out of their chair and participate in a shared physical activity, albeit virtual.

Similarly, before the start of the summer internship program, we shipped LEGO sets to all the interns. This turned out to be very useful because we could easily test and replicate projects because everyone had a similar setup.

### **Implement a feedback-response cycle to keep improving the learners' experiences.**

In addition to regular check-ins with the interns, we took into consideration the interns' feedback as we refined our design for the following week.

## **DISCUSSION & CONCLUSION**

A major compromise we had to make as we redesigned the structure for this year's internship program was to reduce the number of projects that required physical builds like soldering, circuit design, laser cutting, 3D printing, and breaking apart things and instead focus on coding, simulation, and design aspects. Even though shipping the required materials to the interns provided them opportunities to build physical models, we struggled to fully recreate that experience of being involved in hands-on making and engineering projects. But besides that, we were able to leverage existing tools and technologies to not just recreate many elements of the in-person experience, but we were also able to come up with creative ways to enhance the remote internship experience.

Overall, it was a successful and exciting summer, as indicated not just by the end of summer reflections, survey responses and interview data, but also based on the following examples which we believe are true indicators of our success in meeting the CEEO summer internship goals:

### **The student interns are pleased with the summer experience and want to continue working with us.**

Even after the summer internship was officially over, we continued hiring 6 undergraduate students for the rest of the summer—4 of whom are still working for the CEEO for the Fall semester—at their request.

### **The team leads come away with a feeling that their research is advancing.**

There was a consensus among the leadership team that the summer internship experience exceeded expectations and the outcomes were comparable to previous years. The tools/platforms/strategies we experimented with this summer not only resulted in new research data but was also useful for team leads to plan remote research studies and for faculty members to plan their Fall 2020 courses which were either hybrid or completely remote.

### **The industry funders are pleased with the progress and continue funding us in the future.**

Our industry partners were pleased with the outcomes of the summer projects and were impressed with the quantity and quality of the work that was done over just two months by our army of interns. It was encouraging to see how excited they were about the directions we explored, products we created, and technologies we invented. They were appreciative of our time, efforts, and work, even during the pandemic. Further, we were glad to hear that both industry partners would continue funding us and that one of those organizations decided to hire 4 of our summer interns as part time employees.

We hope our experiments, learnings, insights, and struggles are useful for designers, researchers, and educators to build virtual communities that encourage collaboration and communication.

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