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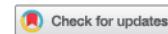
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Student experiences in an interactive synchronous HyFlex design thinking course during COVID-19

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ABSTRACT

The HyFlex learning model has gained popularity in recent years and, with the outbreak of COVID-19, the demand has increased. However, there are challenges associated with the model, especially related to equity and engagement. A HyFlex model known as Interactive Synchronous HyFlex is being developed and practised by the researchers in their introductory design thinking course. The purpose of the paper is to understand the experiences of students using the Interactive Synchronous HyFlex model. A qualitative method in the form of focus group interviews was followed in this study to better understand the student experiences. The focus group interviews were conducted during the beginning, mid and end of the semester. The resulting themes of the study are grouped into two categories: affordances and opportunities. The themes corresponding to affordances are (a) effective model, (b) flexibility, (c) sense of community, (d) ease of communication and (e) help prepare for future jobs. The themes corresponding to opportunities include (a) software learning curve, (b) online non-contributors and (c) inconsiderate face-to-face peers. The results of the study may help faculty and higher education institutions better prepare a version of the HyFlex model taking into consideration the affordances and finding better ways to incorporate opportunities.

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COVID-19 challenged our long-held assumptions as educators that students need to be in the classroom and seated in order to learn. With the onset of COVID-19, educational institutions of higher education were forced to switch, almost literally overnight, from a traditional face-to-face-only environment to an online environment. As the pandemic is approaching the endemic phase, we wonder what education will look like in the future. According to the 2021 EDUCAUSE Horizon Report, the most important technological advancement in the post-pandemic world will be the blended and hybrid course models. “Institutions and instructors previously resistant or indifferent to tools such as videoconferencing, team-based platforms, and virtual classrooms have come to rely on those tools as essential ingredients in their work” (EDUCAUSE Association, 2021, p. 8). Socially, higher education has expanded the accessibility of graduation ceremonies, advising, coffee meet and greets and other key aspects of college life to remote participation.

According to a recent Ipsos survey by the Economic Forum, in 2025, higher education will be a mix of online and in-person learning (Whiting, 2020). The Pandemic has disrupted education and has forced the evolution of online learning technologies and our cultural willingness to leverage these pedagogical strategies. “Faculty and instructional staff will need to continue to discover innovations supported by technology and pedagogical design to provide instruction that is socially and

emotionally supportive and flexible enough to adapt to a wide range of student needs" (EDUCAUSE Association, 2021, p. 7). HyFlex is one of the models proposed as the "new norm" in education (Hardcastle, 2021; Rasheed et al., 2020). In this investigation, the researchers implemented a specific version of the HyFlex model and pragmatically investigated student experiences to understand how and in what ways this model met students' needs to inform future implementation of this "new norm" in active learning design education courses.

Interactive synchronous HyFlex

HyFlex is a general term for the combination of *Hybrid* and *Flexible* learning environments. Hybrid courses are described as courses that are delivered partially face-to-face and partially using online technology (Arispe & Blake, 2012; Johnson, 2012; Sands, 2002). Hybrid courses "replace a portion of traditional face-to-face instruction with online activities (such as video, lectures, online discussions or projects)" (Dhami, 2021, para. 3). In a traditional Hybrid course, the instructor determines which learning experiences are face-to-face and which are online. A HyFlex model could be set up such that "students can choose to attend class either in an assigned face-to-face environment or in an online environment, synchronously or asynchronously" (Beatty, 2019, p. 21).

The research team developed a HyFlex model specific to the introductory freshmen design course to foster active learning work, interaction and collaboration in alignment with the four main principles of a HyFlex model:

1. Learner Choice: Provide meaningful alternative participation modes and enable students to choose between participation modes daily, weekly or topically.
2. Equivalency: Provide learning activities in all participation modes which lead to equivalent learning outcomes.
3. Reusability: Utilize artifacts from learning activities in each participation mode as "learning objects" for all students.
4. Accessibility: Equip students with technology skills and equitable access to all participation modes. (Beatty, 2019, p. 52)

The authors have named this specific variation of the HyFlex "Interactive Synchronous HyFlex" model as it affords *learner choice* such that students choose on a daily basis to physically attend class or synchronously participate in whole and small group works online with their peers. *Equivalency* is a key feature of having all students work synchronously in a single course regardless of their participation modality for each meeting. Students see the same materials and have access to the same supports regardless of their location in the classroom or remotely connected online. Instructors leverage the *reusability* of the course materials as the material (content, assignments, grading rubrics, etc.) are all available online via the LMS and referenced in class for students regardless of how they attend each meeting. The course is made *accessible* to students through a variety of supports including an email announcement explaining the type of HyFlex model in use, a 6-minute demonstration video showing how to interact with face-to-face and remote peers as well as explicit instructions detailing how to navigate the online platform for both in class and remote participation.

Though HyFlex is proposed to be the "new norm", challenges remain. Literature suggested that "Students will need to develop new skills and literacies to be better equipped for remote learning and to better thrive in more isolated and independent virtual environments" (EDUCAUSE Association, 2021, p. 7). Kohnke and Moorhouse (2021) reflected on their HyFlex course transition in response to COVID-19 and emphasized that other researchers should focus on the following issues for a successful implementation of the HyFlex model in higher education:

1. Equity: Teachers need to focus on providing equal opportunity for face-to-face and remote students.

2. **Sense of Community:** To establish a sense of community in the classroom, instructors should consider blending both face-to-face and remote students during group work in the same group.
3. **Communication:** Teachers should consider how to make each experience from the face-to-face environment available to remote learners such as using breakout rooms to facilitate small group work and polls to foster engagement.

While generally, literature on the HyFlex model suggests success in engaging students, there are lingering concerns about the quality of the student learning experience (Buatois et al., 2022; Kohnke & Moorhouse, 2021; Miller et al., 2021). The current investigation contributes to the literature by qualitatively examining student experiences in an active learning environment during the start of the global pandemic driven by the following research question:

How and in what ways did students experience the Interactive Synchronous HyFlex model at the start of the global pandemic in an active learning design course?

Research Context – design thinking course

The research context for the study was a first-year design thinking course offered by Purdue University. The course is a required course for graduation, the first course in a design and innovation minor and satisfies two University Core Curriculum outcomes (Science Technology and Science and Information Literacy). Design Thinking in Technology (Tech 12000) is offered all year long with approximately 18 sections in Fall, 18 in the Spring and around 3 sections in Summer. The main objective of the course is to help students understand, learn and apply design thinking processes which are carried out through the following narrowly focused learning objectives:

1. Write a narrowly focused problem statement
2. Apply ethnographic methods to understand technological problems
3. Develop a search strategy, access technical databases and evaluate results and source quality
4. Create a technical report documenting the results of the design process
5. Manage design projects, develop project timelines and negotiate individual responsibilities and accountability in the team environment
6. Apply strategies of ideation to develop novel and innovative solutions
7. Demonstrate rapid prototyping solutions for purposes of design, testing and communication

The course is structured in the form of three projects – two mini-projects and one main capstone project. The first two projects are focused to help students understand in detail the design thinking stages and the final project helps the students to apply the design thinking processes in real time. In the final project, students are asked to work on a real-world problem that is related to an engineering grand challenge (National Academy of Engineering, 2021) and come up with functional prototypes/ solutions to address the problem. It is important to note that all the projects in the course are group projects and require student interaction and engagement throughout the semester.

The course format was historically hybrid and active in nature, where all the course contents were shared with students before the actual class time through the learning management software. During class time, hands-on activities and discussions related to the beforehand shared course material take place. Most sections are taught by graduate students. The course is managed primarily by the course coordinator who shares the master copy of the course with the instructors before each semester who then customize it with specific dates and times for their sections. As a result, the course follows a similar structure for all the sections. A weekly planning meeting provides additional instructor support and continuity between sections, where the instructors and the course coordinator discuss how the previous week went and lessons learned, address any key concerns and also discuss the coming weeks.

Interactive synchronous HyFlex model in design thinking course

Before the outbreak of COVID-19, the course was taught completely face-to-face for 50 minutes twice a week with no online or remote participation option. With the outbreak of COVID-19, the course switched to the Interactive Synchronous HyFlex model. Each instructor teaching the design thinking class shared the course contents with students through “Brightspace” (Learning Management Software) a few days before the start of the semester. The Brightspace course has a tab called “START HERE” which contains short videos on what to do before the class starts, including which software to download, the need to have a personal laptop and headset, the contact details of the instructor and a FAQ (Frequently Asked Questions) sheet which would help students in case they get stuck on the technological set-up. The design thinking course is offered twice a week for 50 minutes each during the academic year. Typically, the class starts with the instructor sending a calendar invite including a link to the meeting to all the enrolled students through the MS Teams software about 15 minutes before the actual class. This helps students, especially the students participating remotely join especially during the early weeks. As students begin to understand how to use MS Teams they realize that the meetings occur in the general channel and they just navigate directly on their own accord.

The Interactive Synchronous HyFlex design thinking class gives the students the flexibility to join the class remotely or face-to-face synchronously on any given day. Some even join remotely on their way to class if they anticipate being a minute or two late so they do not miss the introduction. The instructor for the course starts the MS Teams meeting 5 minutes before the actual class time and all the students (both face-to-face and remote) connect to the meeting and share their webcam video feed while muting their audio. The beginning of the class, typically the first 5–10 minutes, is dedicated to (a) students filling out the attendance form on MS Teams – which asks students whether they are attending remotely or face-to-face (b) a whole group discussion, where the instructor initiates the discussion on what the students learned for the class and how is it useful for them and (c) the instructor orienting the class to the in-class activity and how the students are expected to complete it. During the whole group discussion, the instructor projects a large gallery view of students onto multiple projectors in the classroom, as well as shares the screen as shown on the right side of [Figure 1](#), thereby all students (face-to-face or remote) are able to see each other and each student’s name. The instructor also records each class meeting, thereby helping any students who are absent (or struggling to connect) know what they missed on that day. After the whole group discussion, students are typically instructed to work with their respective groups in the



Figure 1. Interactive Synchronous HyFlex class (Nickel, 2020).

assigned MS Teams channels. If all the group members are present face-to-face, the students can discontinue using MS Teams if they prefer. However, if there is at least one group member connecting remotely in any group (or) if the entire group is joining remotely, the group is required to work via MS Teams, share their audio and video, as well as record their small group meetings in their respective group channel. An Undergraduate Teaching Assistant (UGTA) is present in each class to help the instructor and students during class time. One responsibility of UGTA is to maintain awareness of the interactions between remote students and face-to-face students, including helping them with any technology or connection-related issues and monitoring that all remote students keep their cameras ON (which we are learning is a key piece for accountability and engagement). During the entire class time, any student (remote or face-to-face) can ask the instructor or UGTA questions in the following different ways, (a) via personal chat message through MS Teams which is only visible to the instructor, (b) general chat message in the course MS Teams channel visible by everyone, (c) inviting the instructor to join the small group meeting through MS Teams and (d) personally starting a video call with the instructor. Each instructor has a screen recording software installed and ready such as “Camtasia” which allows the instructor to record their screen and class interactions in case there is a university-wide internet shutdown to be shared after the network is restored.

Method

A qualitative phenomenology method was used in the study to understand in detail the perceptions and experiences of students in an Interactive Synchronous HyFlex model approved as Purdue University IRB #2020-1260. Phenomenology is defined as a study of people's conscious experience of their life world, that is, their everyday life and social action (Merriam & Tisdell, 2015; Schram, 2003). As Patton (2014) described, in phenomenology, the experiences of different people are bracketed, studied, analyzed and compared to identify the essence of the phenomenon under study such as being a participant in a particular programme. The main aim of this study was to analyze the live experiences of students in our Interactive Synchronous HyFlex classroom and use the results to guide future course improvements. A focus group interview technique was used to collect data for the study. A focus group interview is defined as “using a semi-structured group session, moderated by a group leader, held in an informal setting, to collect information on a designated topic” (Carey & Smith, 1994, p. 124). The designated topic in this case is the Interactive Synchronous Classroom. According to McLafferty (2004), the primary advantage of using focus group interviews is the meaningful interaction between participants to generate data.

A census sampling method was used to get maximum participation in the study. The researcher sent an announcement to all the instructors of the design thinking course three times (beginning, mid and end) during the semester in Fall 2020. The announcement articulated the purpose of the focus group interview and also a link with different time slots for the students to sign up to participate. The focus group interviews were conducted virtually through MS Teams (as the software was familiar to the students) and were in the form of semi-structured interviews. In each focus group, the first 5 minutes were dedicated to briefing students about the purpose of the focus group. Each focus group interview was 45 minutes to 1 hour long. As an incentive, students were offered extra credit towards their course grade of about 0.5%.

Table 1 shows the focus group composition for the study. The researchers conducted multiple focus groups with the intent of increasing participation. The researchers also made sure that

Table 1. Focus group composition.

Focus group information	# Of focus groups	Total participants	Male participants	Female participants
Beginning of semester	9	49	28	21
Mid of semester	5	19	15	4
End of semester	5	16	10	6

there were no more than 6 students in each focus group to obtain maximum input and engagement from the students. If there were more than 6 students signed up for the same time slot, multiple focus groups were run concurrently to accommodate student interest. Table 2 shows the demographic information obtained from the college database of all students enrolled in the design thinking course during the Fall 2020 semester.

During the focus group interviews, students received information regarding the purpose of the focus group. The anonymity of participants was discussed before the start of focus group interviews and students were asked to genuinely participate and communicate during the focus groups. All focus group interviews were recorded and securely saved for data analysis.

Data analysis

During data analysis, all the recorded focus group interviews were transcribed using a computerized transcription service and imported to NVivo 12 software. An inductive coding approach was followed in the study to allow themes to emerge. According to Yukhymenko, inductive data analysis is an

... iterative process with the raw data read and re-read multiple times and codes, themes and categories continually defined, refined, clarified, and amended. During the final step of inductive analysis, a researcher should not only familiarize oneself with data, but also gain understanding of the events. (2014, p. 6)

In each semester, beginning, mid and end, after conducting three focus group interviews, the researchers realized a saturation in student responses. This saturation was also highlighted during the memoing process. While analyzing the data, an initial review of the data was done by listening to all the focus group recordings and reading all the transcripts multiple times. The recordings and transcripts were also compared with memos to ensure confirmability. The second round of memos was written which were then used to build initial codes. The same procedures were repeated to ensure all the codes are captured. The initial codes were then grouped based on similar meanings/information/experiences into final themes.

Trustworthiness

To ensure the trustworthiness of this qualitative phenomenological study, the four of five steps: credibility, transferability, dependability and confirmability mentioned by Guba (1981) were implemented. To ensure credibility, the researchers of this study wrote memos throughout the focus group interviews and used the memos for peer debriefings (Connelly, 2016; Polit & Beck, 2014). The memos also helped the researchers to interpret and make meanings while analyzing the qualitative data. Transferability is supported by providing thick and rich descriptions of the findings. Dependability was addressed by providing a structured thematic analysis. Also, an audit inquiry, where an external researcher audits the consistency among method, data and hypothesis

Table 2. Demographic information of students enrolled in the Fall 2020 semester.

Demographic	Variable	Fall 2020 Count (percent)
Class Rank (by credit hour earned)	Freshman	421 (67%)
	Sophomore	132 (21%)
	Junior	40 (7%)
	Senior	22 (4%)
Gender	Female	141 (23%)
	Male	475 (77%)
Ethnicity	White	461 (75%)
	Non-White	142 (23%)
	Unknown	10 (2%)
Residency	Domestic	598 (97%)
	International	18 (3%)

(Lincoln & Guba, 1986), was conducted following proper procedures and documenting it. Throughout the data collection and analysis process, researchers were discussing the meaning-making of the themes and came to a consensus, thereby achieving confirmability.

Results

As the post-pandemic importance of the HyFlex model is becoming evident in literature, the themes that emerged from the data analysis were grouped into two categories to help instructors and other key university stakeholders understand student experiences with the model for future improvement. Table 3 summarizes the key themes by the category and includes a brief description of each.

The student experiences with the Interactive Synchronous HyFlex model provided insights into the affordances of the model that provided to students and opportunities for improvement. The category of affordances will be described through each of the five related themes followed by opportunities and its three related themes.

Affordances: effective model

The theme-*effective model* was the most frequently coded theme during data analysis. Multiple students in each focus group described that the Interactive Synchronous HyFlex model was effective and provided a similar classroom and learning experience just like in a “normal” classroom. Some of the student comments from the focus group mentioning the model’s effectiveness include:

Its [Interactive Synchronous HyFlex model] really great. Like, we’re all going to classes, I don’t know how many in person classes you guys have, like I have like all in person classes. So like, one of my group members was exposed to COVID, and she couldn’t come to the group. But she was on team and she was really talking to us. And she was still the same person like she was when she’s in class. So I feel like without this model, we just would have missed her input for the day, which wouldn’t have been helpful. So with the model, she was able to still be there and like, talk to us and give input and help us with that day’s work.

So, my experience, I was attending face-to-face for a long time. I think a month into it, I made the choice to go home. I live two hours away from Purdue. So, I’m home now. And so, I’ve kind of had to blend the distance learning and what I’ve learned face-to-face. And I think we’ve been doing a very good job at keeping it very equal, and not leaving too much out or anything. Yeah, and everyone’s been very inclusive, and everything’s accessible, either face-to-face and distance.

Even though many students did understand the value of the model during the time of COVID-19, it was interesting to note that some of the students did talk about how this model was inclusive and supportive of different learners. For example, students who were anxious to participate in a class or were shy to engage with peers or instructors felt comfortable engaging and participating during class time which was mentioned by students:

Table 3. Summary of themes.

Category	Theme	Description
Affordances	Effective Model	Student reflection about the efficacy of the model or where students discussed continued use of the model for future.
	Flexibility	Students talk about the model providing them with different modes of joining the class or how they engaged in the class from different locations.
	Sense of Community	Students’ ability to connect with instructors and peers during and outside class.
	Ease of Communication	Students’ ability to communicate freely and effectively with peers and instructors.
	Help Prepare for Future Jobs	Students’ perception of how the model helps prepare them for the future workplace.
Opportunities	Software Learning Curve	Learning the software interfaces to enable HyFlex was a concern for students.
	Online Non-contributors	Online students had dramatically low participation which impacted the workload of their peers.
	Inconsiderate face-to-face peers	Online students felt ignored by their face-to-face peers.

Well, I think some people might have anxiety or don't like crowds. So, it's easier for them to pay attention. And it's a more comfortable environment for them, like, you know, in the safety of their own room or their own house. And I also think that it works for people who prefer an in class learning experience, because they can just go to class and get what they need. And so, it works for most of the people that way.

I always get fearful when like, professors near me because it's like, I always fear that I'm doing it wrong. So, then I get nervous, and then I don't say things or do things, right. So like [in this model], the fact that I had no idea that the professor was directly watching me, made it comfortable to present ideas and I've been good.

The majority of the students who attended the focus group had some form of remote learning experience during the semester. The fact that students were able to engage just like a normal class without getting distracted during class time was appreciated by the students:

I agree that I really like how Tech 12000, when you're have classes, you are engaged in it, it's very easy for my online classes for me to just put on the lecture and do something else. But I like, even when I am doing distance learning, I'm able to really be involved in time. And I like how we do breakout rooms with students. So it's not just sitting there listening to a teacher talk all day. It's kind of like, everyone has their own say, and we get to participate more.

I appreciated this model the most out of all the classes where it's hybrid like in person online like depending on what you want synchronous meetings online and like you kind of have to go to class because your group is relying on you versus some of the other ones that were like I think I felt the most like inclined to go to this one again mostly because of the group aspect of it. And like you know, I was also in like the in-person section but I ended up going to most of the meetings online and I didn't feel like that was a major impediment to getting work done with my group or anything. Like we were so able to coordinate when to do work and get up and all that.

Affordances: flexibility

As the HyFlex definition suggests and as mentioned by literature on HyFlex, flexibility was another theme talked about by students during a focus group. All students agreed to the fact that the flexibility offered by the Interactive synchronous HyFlex model in terms of joining remotely or face-to-face on any given day was one of the key values of the model. The final focus group being conducted during the peak COVID outbreak may have helped students appreciate and relate to the importance of flexibility for joining classes. The flexibility was often referred to as the word "option" by students. One of the students mentioned that "there was like a two-week period where I couldn't go to class because I was exposed to COVID. It was definitely nice having that option [flexibility] rather than not being in a class at all". One student mentioned flexibility as the key benefit of the model because they felt that

As long as you have a computer and internet connection, you are able to be there and learn live. You can just choose whatever environment is the best for you. It's nice to be able to go wherever you want, you can still do it. But also, if you need help, and you want to go in person, you have that option as well. So, it's nice to have options. And it's also just kind of nice to be to have it available kind of wherever and have no pressure to be in person. If you have something going on, you can easily just kind of do that. So, it's really accessible. And it's really nice to have.

Not only did the students appreciate the flexibility the model offered, but also the ease with which they could flexibly join the class. Students mentioning "it's really nice to be able to just hop on and attend class" gives the impression of a smooth and easy way of joining the class no matter where they were.

The researchers also suspect that flexibility is also a synonym for autonomy by many students. The majority of students wanted to get back to a normal physical classroom set-up but with a sense of personal control of their learning environment post-pandemic. This was reflected when students asked to continue with the model post-pandemic and in the way they talked about how it is going to be helpful such as

I think that it is very good for the long run because it'll help lessen like the contagiousness of flu because students still go even when they are sick you know, they miss out on classes. This model will take the pressure off the students to be in class when they are not feeling well.

I think regardless of COVID, having the option to attend virtually or in person, would work best, because like, even though I prefer things in class physically all the time, stuff happens. Like if I forget to turn on my alarm the night before and I oversleep, um, stuff just happens, but I don't want a mistake to completely ruined my day. So I like having that option to learn to pop on either virtually synchronously or asynchronously. So I still get the information despite if something happens that prevents me from going to class.

Affordances: sense of community

As cited in the literature at the beginning of the paper, mental health of students related to isolation was a primary concern by university presidents in the time of pandemic. The theme sense of community was mentioned by students in the focus groups as a connection and interaction that they felt with their classmates and instructors during and after class hours. A few student comments related to sense of community theme included:

This class is probably one of the most engaging online classes that I've had, partially because of the webcam and things like that. I know a lot of other online classes, the professor will just talk and talk and you don't have to put your webcam on, you don't have to put your mic on. So you could just easily zone off, not pay attention, sit on your phone, but because of the webcam, and because you have to actively participate. It's super hard to not focus in class. So I'm actually learning a lot better with this model.

I liked working with different people and kind of moving around because then you get to meet new people. But I really feel like tech 120 trying to like be in person and actually working with people. That was like, that's like the best part of the class because my other class that's not online, or that is only online. I don't get to meet anyone, I don't get to work with anyone. So I feel like just being in class, that's like the best thing.

This is this class, I felt the most community than any other class to be honest. And I tend to don't really get to know people in my class unless I have to. Just kind of introverted, but I'm just more familiar with my classmates in this class, and in any other class right now.

Not only did the students feel connected with other students, but also during the time of COVID, this model made students enjoy the design thinking class and have fun in the class because of the elevated sense of community during a time of social distancing. This was mentioned by a student :

That [design thinking] was actually one of my favorite classes just because of the interaction component of it, which was not present in any of my other courses, except for like, maybe Band. But, you know, it was a lot of fun. Honestly, even though you know, some of the coursework was challenging. I feel like just the fact that we got to use this type of flex model [Interactive Synchronous HyFlex model] was really cool and it made the class interesting,

Another student added that all the courses he took during the particular semester of the study were completely online and, therefore, he was isolated to his room for every course. As per the students' words, "All other courses absolutely taught me in my room and this was the only class where I met some people and it's pretty awesome".

Reviewing different student comments on the theme sense of community gives an overall picture that the Interactive Synchronous HyFlex model may help address some of the issues related to mental health on campus. Students who are nervous or anxious about coming to campus due to COVID or any other circumstance can still connect with their peers and instructors just like in a "normal" class.

Students also believed one key factor that contributed towards enabling a sense of community in the Interactive Synchronous HyFlex model is the requirement of having a webcam for everyone during class time, especially the groups having remote students. According to a student, "if we didn't have the webcams, I can guarantee you half the people wouldn't actually participate, they just sit there or they do a ton of other stuff and not focus".

Affordances: ease of communication

The ease of communication theme emerged when students felt at ease in connecting and interacting with their peers, instructor and undergraduate teaching assistant easily and comfortably. This is especially important as the [blinded] course is a high group interaction-based class where student success depends heavily on interaction with peers and instructors. According to a student, “there is a lot more communication with the instructor, which is cool”. Student comments related to ease of communication mainly spanned two sub-themes, (a) ease of communicating with instructors outside class hours (b) remote students’ ease of interaction with the instructor.

Subtheme a: ease of communicating with instructors outside class hours

According to students, it was much easier to communicate and connect with instructors outside class hours compared to a normal semester. Some of the students’ comments explain “ease of communication”:

I felt like it was pretty easy to connect with the instructor. I sent, you know, emails, if I miss class and response times were pretty good. I also noticed that my instructor left a scheduling link for teams [MS Teams] calls at the bottom of his contact information in the email. So if you had like a problem or you wanted to get in contact with him, you could set one up there pretty easily. That was kind of automated and then you go to that thing that would link you to the call or whatever and then you’d be able to meet with them. So he was pretty open to Using the technology to meet with students and figure things out, which was great. He was pretty great with that.

If I ever had question or anything, I just messaged her [instructor] on teams, and she messaged me back, like, right away, always. So that’s really nice. And that’s not really in class. But that’s something that she does. She kind of focuses more on the MS teams rather than email, which I like.

I like how the instructor joined our meeting sometimes which made me more involved like in the class. It just felt like us, we were the only people and you were able to like help us with our individual questions, and stuff like that [individual attention to the groups]. So, I just really liked how sometimes you just pop in [to MS small group channel] and see how things are going.

Subtheme b: remote students’ ease of interaction with the instructor

As per prior literature, many remote students feel isolated and not able to connect to their instructors and peers in terms of learning. It was interesting to see that in the Interactive Synchronous HyFlex model, students who joined remotely occasionally were able to connect with the instructor and undergraduate teaching assistant just like the way they would in a normal classroom which was confirmed from the following student comments:

I did actually have a couple interactions with like my TA and the professor via teams [MS Teams]. I think there was like, one time I was online, but I was having some issues getting like a good connection or something. And so, I was able to actually, like, talk to them via MS Teams and kind of communicate what was going on without like losing in any way information because they were pretty on top of it and were able to like kind of really get me like, back up to speed from what I missed.

I have a lot of classes that are really just, you know, read off the slides, and take a quiz. And it’s really difficult to interact with the professor, other students, because you don’t know who else is in the class and kind of what’s going on, especially on the days you’re not in class, it’s really difficult. Like you have to put your questions in the chat or something, and then hope that the professor sees it. Whereas in this case, it’s super easy to interact with both the professor and your peers if you have to work asynchronously for any reason. And it really helps, since it’s a team based, project-based class, the fact that we’re able to use teams, and I mean, I’ve been really impressed with how well it’s worked. So I really have enjoyed this learning model, compared to my other asynchronous classes.

Affordances: help prepare for future jobs

The overarching learning objective of our Design Thinking course is to equip students to solve real-world problems and enable them with the 21st century skills required by the workforce. Even though this has

been the learning objective of the course for the past few years, none of the student comments on evaluations ever talked about the value of the course learning objective. But with the Interactive Synchronous HyFlex model in place, it was interesting to see how students were easily make a connection between the model and the future workforce requirements. A few student comments on this theme were:

I would say it gives us an opportunity to kind of grow as, as professionals, this is definitely something we're going to have to be able to do in our professional lives. And so, I think, this experience of being able to be in person, hybrid strategy like it, because I know just from experience with, like, how my parents work and stuff like that, like being able to interact with someone online, when you can't meet in person is, is a huge deal. And so, it kind of opens us up to be better students and professionals later down the road.

I think it's really good to help us in learning to adapt to any situation, being able to like you were talking about, basically, including people that were online and people that weren't online, so everyone feels like they're contributing enough. Being able to adapt to any situation like we are being right now, that is very helpful in any field. My brother works for Capital One and currently, they sometimes work online, and sometimes they don't. And so, he's just been telling me that he's just staying at home and being able to do online, zoom meetings and online team meetings, they have TVs, they have team games online, they do pretty much about everything online. It's amazing to try and adapt to the society or the condition given instead of trying to conform to it.

I think that in the future, sort of an online workspace, where you can work remotely from your home, and then bring that work to the headquarters of the company, I think that's going to be something we see a little more often. Because then companies realize we can better allocate our infrastructure, like actual hands on work instead of we need places for people to sit down and just work. So I think online components, especially after this, even when the virus is contained is going to become more, I would say, relevant in the future. So the fact that we're getting this experience, like [another student] said, like everyone said, here, is really going to be beneficial by the time we graduate.

As mentioned in the last comment by the student, many other students also talked about the importance of the model for the future. According to students, joining an online call or navigating online platforms or interacting with remote persons has become more like a common thing that they do in our classrooms.

Opportunities: software learning curve

Software-related issues and learning curves related to the HyFlex approach were coded many times during the data analysis. But, it is important to note that students' comments related to this theme were predominantly at the beginning of the semester. The Interactive Synchronous HyFlex model had both remote and face-to-face students interact at the same time using MS Teams through earphones and an issue related to hearing an echo was the major software difficulty mentioned by students as below.

No, it's been fine. Um, I because like I said, at first, it was kind of weird to hear the professor like, twice, like you hear them in your headphones and in person. But you can, I mean, we all quickly figured out that, like, you can just turn the sound on your computer, on your headphones. So, you can only hear them in person. And then when you're in group with somebody who's remote, you can just turn it off, so you can be able to hear them. But yeah, I mean, at first, it's a little weird. But I mean, once you figure it out, it's fine.

You know, when we're in class, sometimes you know you're toggling between teams and the google doc and something and you can always go back to teams to mute and unmute while you're typing. And so sometimes, you know, you still do get instances of feedback and people talking over each other. But overall, for me, the issue has improved slightly.

So, I mean, it didn't really matter if you're in class or not. I mean, sure, the echo was kind of annoying at times. I'm sure it was for people in class. But, you know, you kind of just get over it eventually, at one point, so I felt like it didn't really make a difference.

During the mid- and end-of-semester focus group interviews, none of the students felt software or technology challenges were a significant concern. Even when asked directly during the end-of-semester focus groups, students categorized the software challenges as "annoying", but, not "disruptive".

Opportunities: online non-contributors

The online non-contributor theme was a result of student comments related to some online students' lack of participation. Students talked about ways of ensuring that remote students were accountable especially in small group work. One of the students mentioned that getting work done becomes "little harder if they [remote students] do not input as much information as you would want". Two other student comments related to remote students not contributing towards small group work at times include:

... some people do take advantage of having the choice to go in class and doing it from streaming. And I know some students that say like, oh, all I do is just log in, I don't have to turn on my face camera or anything. And they just go back to sleep.

My biggest challenge is that when my teammates go online, they often do not contribute at all, they just stay muted and aren't involved. So, I think that's one of the biggest problems because they're more likely to be engaged in class. And they aren't, they either do not show up online or they do not participate.

We conclude that it is evident from these and other related comments that even though only some remote students were failing to contribute compared to their face-to-face peers, non-contributing remote students did create a negative impact on their face-to-face groupmates. One of the face-to-face students mentioned in the focus group that "it does have a lot of responsibility on the students to have it online. And some students take this responsibility whereas others don't". All the students unanimously agreed to the fact that it is important for the students, especially remote students to be accountable and "if they don't do their work, it's like affecting the whole team".

Opportunities: inconsiderate F2F peers

Online students felt that some of their face-to-face group members were inconsiderate of them during class hours. Some of the remote students mentioned that they were sometimes "ignored" by their face-to-face peers during in-class group work and they weren't able to contribute much towards their class work even when they wanted to, for example:

I actually went through something similar. But the other way around. I know that one day, I decided to go online because I wasn't feeling very well. And all my other classes were online. And they were back to back. And we were in groups. And except for this one person, nobody had their headphones on. Nobody was talking into the mic. They were just talking to each other. And I kept saying stuff. And I tried to say it as loudly as I could. But I didn't know they didn't have their headphones on. But I felt like they were ignoring me. And I couldn't hear what they were saying. So I was out of the loop. And the whole class was just really like that one class period was really bad for me because I had no clue what was going on. So I had to have somebody take their laptop to the professor at the end of class to talk to him about it. And we ended up switching groups.

I think it would have been nice to have something or like someone to hold the people in the classroom accountable for making sure that they were like, including the members who weren't able to be there in person. Maybe like, coming around to like check that they were on, like, on the call or something like that.

... my roommate had COVID. And like, I was in quarantine for like two weeks. And then I felt like when I was online, and kind of like, I was just like there. And it was hard to like, add something to the group, when everyone's right next to each other. And people kind of like, don't pay attention to what you're saying or doing. And you feel like you're like just there. And you're like, your team's doing all the work.

It was interesting to note that some of the face-to-face peers also acknowledged the fact that they were sometimes relaxed about wearing earbuds which prevented them from listening to the remote students in their group:

For me, when we're working in when we're working in our small groups, if there's if the minority of people in our group is attending virtually, it's very easy for me to forget about them. Because then at least for this project

to my group has been doing pretty much everything through Google Docs. So I had to minimize the MS team so I don't see anyone through the computer so then the only people in front of me are the people in those who are sitting at my table sees a gap out the people are outside of them.

I think that there was some faults on our part, in terms of there were there were ways that we probably could have in our interacted with it better. For instance, sometimes not all of us brought mics. And that's something that's on the syllabus that you bring a headset and a steady internet connection. And obviously, when you don't have a mic, and I'm talking, like I mentioned, classroom is just full of voices. So when you don't have an isolated mic, your computer microphones picking up everything in the classroom, which makes it difficult for you to hear and it makes it difficult for the people at home or online to hear you as well.

Conclusion and discussion

The Interactive Synchronous HyFlex design thinking course was implemented following the four principles of the HyFlex model: learner choice, equivalency, reusability and accessibility (Beatty, 2019, p. 52). *Learner choice* was enabled by providing students the option to join remotely or face-to-face for every class meeting on every single day. Classroom recordings of both whole groups and small groups were provided adding to learner choice. Designers and instructors of the Interactive Synchronous HyFlex model made sure to provide an *equivalent* learning experience to students who participated using different modes. All instructors wore a headset with a single earpiece to ensure they could listen to both remote and face-to-face students. If a face-to-face student had a question during the whole group discussion, either it was asked using MS Teams audio or the instructor would repeat the question. Similarly, learning materials and contents used for the course and during the class were available and accessible to all students enrolled in the class ensuring *reusability*. To provide *accessibility* to students in the Interactive Synchronous HyFlex model, both face-to-face and remote students were asked to use MS Teams software, record the meetings, post on the discussion forums, use mute and unmute while communicating with their remote peers and use the chat function. As the students had the option to choose their mode of class participation every single day, it was important for all students to easily navigate and communicate using the MS Teams software. The results of the study indicate that students overall appreciated the model, especially the combination of flexibility and effectiveness. The quotes related to flexibility mentioned by students very well align with the learner choice principle and they appreciated having different options to join and participate in class. The equivalency principle was reflected by students as a part of the model's effectiveness. Students mentioned the way they were able to join remotely or face-to-face and still able to have a very similar experience in the design thinking course. Reusability as a theme was not mentioned by students explicitly but was touched upon by the fact that the students had a very similar classroom experience. In terms of accessibility, students mentioned that they had an initial software learning curve at the beginning of the semester but which later on was not a concern for them. Students also reflected that they knew how using technology in the HyFlex model is going to help them in their future jobs and internships.

Implications for practice

Based on the quality of students' learning experiences with the Interactive Synchronous HyFlex model, the instructional team continues to offer the design thinking course while refining the model. Students continue to have the choice on a daily basis about how they will participate in class meetings. With respect to the theme "sense of community", the instructors encourage whole group and small group interaction across face-to-face and online environments throughout project work and reflective discussions. Instructors are also leveraging opportunities to extend traditional face-to-face discussions into online platforms such as the LMS discussion forum, the

video conferencing platform (MS Teams) postings and other platforms such as “LinkedIn”. In terms of “ease of communication”, students are provided multiple ways to communicate including using their own audio equipment or borrowing a USB conference room quality desktop speaker/microphone for classroom use from the instructor. Background noise suppression has improved which results in even more comfortable classroom conversations. The researchers were pleased to discover that the students themselves realized how the HyFlex model is helping them prepare for the future workforce. To support students’ preparation for a global economy, instructors and UGTAs continue to share with students how their work life and internships may span face-to-face and remote environments. Instructors increasingly encouraged students to use MS Teams software to schedule meetings and to conduct fieldwork for the class project outside class hours.

The researchers carefully reflected on the opportunities shared by students during focus group interviews to improve the model and student experience. To help reduce the software learning curve, preparatory videos on how to navigate the software before the first in-class meeting have been created, edited and shared with students. Instructors also provided students with explicit expectations about how to engage with other students in the HyFlex environment through discussion and video examples. To address the issues related to face-to-face students not engaging their remote peers and vice versa, instructors explicitly shared their expectations that students try to engage their peers and record their interactions to increase accountability and participation. Instructors also emphasized the use of cameras for all students while blending small group work. In addition to this, monitoring is done by UGTA during small group meetings and students were marked absent if found not participating. An online peer evaluation tool (CATME) will continue to be used to hold peers accountable during classwork and instructor-led classroom discussions making the connection between engagement and CATME as a measure of engagement.

The Interactive Synchronous HyFlex model became a part of the student’s normal life after a few weeks of navigating a software learning curve. Even though most of the students who joined remotely were accountable and contributing towards the course work, there were a few students who may have taken advantage of the system and offered very few contributions. Similarly, as it takes a little bit more effort on the side of the face-to-face student to accommodate online students, some of the face-to-face group members either ignored or did not like the fact that there were remote students in the group. As we write this paper, there is some uncertainty about the variants of COVID-19, and universities in-the-near-future semesters might need to accommodate students in quarantine or isolation. The results of the study may also help universities and faculty who want to adopt a HyFlex learning environment in their classrooms, especially on what factors to focus on for efficient implementation of the model.

Future research

As a first step of future work, the researchers will be learning about the experiences of instructors teaching the Interactive Synchronous HyFlex model. Instructor experiences will help to understand the pedagogical challenges mentioned in the HyFlex literature. Also, future research will investigate the extent to which the Interactive Synchronous HyFlex model complicates student contribution to team projects compared to the simplicity of face-to-face only classrooms. With online and face-to-face students engaging in small team-based projects, future research might explore methods of accountability and how they may impact participation and learning.

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Appendix 1

Focus group interview questions

1. What can you tell me about your experience in our HyFlex classroom related to blending face-to-face and remote?
2. How does our course compare to your other learning experiences?
3. If you were or considered participating remotely, why?
4. Is accountability and motivation any different in our course?
 - a. Do you feel motivated to participate face to face if your peers are remote?
 - b. Do you feel equally motivated if you are participating remotely?
 - c. What strategies does your instructor (or do you) use to maintain or increase motivation to engage?
5. Is there any difference in the learning experience being face-to-face or remote (or blending within a small group)?
6. How do your peers' choices to be remote or face-to-face impact your learning experience?
7. Our learning experience is collaborative, how does our HyFlex model impact your sense of community?
8. What benefits do you experience in the HyFlex model?
 - a. For you as a student?
 - b. For your instructors?
9. What challenges do you experience in the HyFlex model?
 - a. For you as a student?
 - b. For your instructors?
10. Are the benefits and challenges similar for all students or are there some students who have different experiences?