COMPARING REMOTE AND ON-CAMPUS LEARNING EXPERIENCES AND INTERACTIONS IN A BLENDED SYNCHRONOUS LEARNING ENVIRONMENT

Sara M. Tamsukhin, Arkansas State University-Jonesboro
Janet Mannheimer Zydney, University of Cincinnati
Alex Nakonechnyi, Mount St. Joseph University

ABSTRACT

Blended synchronous learning provides students flexible attendance options for class sessions. This study explored the experiences and interactions of remote and on-campus students in the blended synchronous classroom using a protocol pedagogy framework and a 360-degree camera. This multimethod study included observations and video recordings of two class sessions and a postcourse survey. The participants were nine graduate students in a learning sciences and technology course. Students rated remote and on-campus audio and visual experiences similarly. Increased participation was observed from session one to session two. Mean interactions of remote and on-campus students were 7.25 and 9.17, respectively. Overall, remote interactions were comparable to on-campus interactions.

Keywords: *blended synchronous learning, remote learning, 360-degree camera, discussion protocols*

INTRODUCTION

Many students may prefer face-to-face classroom instruction because of the immediate feedback from their teacher and social interactions with other students (Altiner, 2015). However, it is not always feasible for students to attend on-campus classes. Therefore, students may prefer remote learning due to its flexibility (Thai et al., 2020). Blended synchronous learning is defined as "learning and teaching where remote students participate in face-to-face classes by means of rich-media synchronous technologies such as video conferencing, web conferencing, or virtual worlds" (Bower, Dalgarno, et al., 2015, p. 1. This learning approach is distinct from blended learning, which simply combines in-person and online elements.

More higher education institutions are incorporating blended synchronous options to improve flexibility and increase accessibility for students (Bell et al., 2014; Wang et al., 2018). Blended synchronous learning provides an alternative for students who cannot attend classes due to illness, bad weather conditions, or other personal challenges (Wang et al., 2018). For example, students with physical disabilities may not have equal opportunities to attend on-campus classes (Norberg, 2012). Blended synchronous learning environments may allow students to attend classroom instruction even when they cannot physically make it to class (Wang et al., 2017). One of the issues noted in a recent review of the literature on blended synchronous learning environments is the challenge of engaging remote students in what is happening in the classroom (Raes et al., 2020). Remote students tend to take on a more passive learning role, watching what is happening in the classroom, unless the instructor uses strategies to engage them (Conklin et al., 2019). Lakhal et al. (2020) recommended structured discussions to ensure that all students have an equal opportunity to participate.

Protocol Pedagogy Framework

One pedagogical solution that may help remote students take a more active role in blended synchronous learning environments is the use of a protocol pedagogy framework (Zydney et al., 2020). A protocol pedagogy is an instructional approach that promotes thoughtful interactions through structuring discussions. This framework is designed to prompt the active participation of remote students, create an equitable learning environment, foster trust through establishing norms, and encourage connections (Zydney et al., 2020). Key to this approach is the use of a protocol, which specifies a clear purpose for the discussion, the roles participants play within the discussion, how those roles interact with one another, and the timeframe of those interactions (McDonald et al., 2012). In other words, it provides "directions for who should speak at a particular time and for how long, and who should listen at a given time" (Zydney et al., 2012, p. 77). To do this, many protocols use something called a Go Round, where each person takes a turn to speak for approximately the same amount of time. This technique may prompt remote students to participate more actively. By creating specific rules for how people interact with each other, protocols help students to trust and feel safe in the environment as they have clear expectations on how to work with one another (McDonald et al., 2012). Although this is helpful for any classroom, it has been found to be particularly useful for blended synchronous learning classrooms because they are so new and unfamiliar to students (Zydney et al., 2020). Simply by establishing a norm that encourages remote learners to jump into the discussion may also help students feel safe to take risks and contribute their perspectives, rather than just passively listening to what others in the classroom have to say. For sample protocols that can be used for live discussions, please see this online resource: https://www.schoolreforminitiative.org/protocols/

LITERATURE REVIEW

Blended Synchronous Learning

One goal of the blended synchronous design is to attempt to provide all students, regardless of attendance mode, with equivalent learning experiences (Wang et al., 2017). "Learning experiences can be defined as learners' perceptions, responses, and performances through interaction with a learning environment, educational products, resources, and so on." (Huang et al., 2019, p. 94). Sometimes the design and technology used in the classroom can positively impact the learning experiences of students in one attendance mode at the expense of students in another mode. Remote students can feel both excluded and included in a blended synchronous class (Olt, 2018). For example, remote students may feel more disconnected from the instructor and classroom (Bell et al., 2014). Furthermore, remote students can feel like outsiders when they are asked to mute or must interrupt to get the instructor's attention (Olt, 2018). On the other hand, some remote students have reported feeling included in the classroom through such means as direct questions from the instructor (Olt, 2018).

Design and technology can also impact on-campus students' experience. Researchers have tried a variety of classroom set-ups, such as individual computers or iPads displaying an individual remote student or large screens with multiple students. For example, Bell et al. (2014) noted that individual displays in the classroom for each remote student helped on-campus students feel more connected to remote students. On the other hand, some classroom designs can feel uncomfortable for on-campus students who need to take on additional roles to support remote students, such as moving an iPad or computer for the remote students to have a better view (Bell et al., 2014; Cunningham, 2014) or using a microphone in the classroom (Szeto & Cheng, 2016; Wang et al., 2017). On-campus students can be reluctant to help and sometimes express resentment towards remote students (Cunningham, 2014). These sentiments can make remote students feel unwelcome (Bell et al., 2014; Cunningham, 2014).

Recent studies have demonstrated the benefits of blended synchronous learning on improving experiences for many students. For example, students who would otherwise be unable to attend class due to illness, childcare issues, or temporary physical issues can attend classes through video conference (Angelone et al., 2020). Although these students were grateful not to miss class, their experience participating was not always optimal due to technology issues. For example, it was challenging for students who were not physically in the classroom to clearly hear what was happening because of audio issues, such as background noise and

audio interference (Zydney et al., 2019). To help resolve this issue, interconnected speakerphones were purchased to provide better audio coverage for the whole room and the quality of the audio significantly improved as a result. However, a better visual solution was needed (Zydney & Angelone, 2018). Findings indicated that remote students desired a more fine-grained visual of on-campus students (Zydney & Angelone, 2018). Providing a birds-eye-view of the classroom through the ceiling camera made it difficult to see faces. The camera angle may have contributed to the positioning of the remote students as observers rather than active participants. Remote students felt unsure of when to speak when taking turns due to the lack of nonverbal clues. As such, some students chose to stay out of the discussion for fear of speaking out of turn, hence limiting their engagement.

Remote students tend to face an uphill battle in terms of achieving full participation because nonverbal communication, which delivers more than half of the meaning in the course of human interaction, is difficult to discern absent a high-quality video (Betts, 2009). Hence lies the apparent paradox—the technology that was intended to assist students in overcoming barriers to participation also serves to restrict their ability to fully partake in the learning environment. Like students, instructors may also have challenges in the blended synchronous classroom.

Differences in skills and knowledge between on-campus and remote students can also be a challenge for instructors (Yang et al., 2019). Instructor effort to make sure that remote students can see/hear each other can sometimes result in less attention being paid to the classroom instruction (Wang et al., 2017). This could be a distraction that affects students' learning and satisfaction (Yang et al., 2019). With preparation, instructors can reduce or eliminate challenges that both they and students face in the blended synchronous classroom.

Virtual Presence

Past research indicates that students participating in blended synchronous courses must overcome two major hurdles associated with this modality of learning: inability to pick up on nonverbal cues of other class participants and difficulty understanding the audio (Romero-Hall & Vicentini, 2017). These challenges are inter-related as nonverbal messaging plays a significant role in promoting student comprehension in virtual learning environments (Sathik & Jonathan, 2013). Most of these technological solutions aim to enhance both the clarity of audio as well as provide means of enhancing the sense of presence. "Presence is defined as a state of alert awareness, receptivity, and connectedness to the mental, emotional, and physical workings of both the individual and the group in the context of their learning environments" (Rodgers & Raider-Roth, 2006)

Several technological solutions have been developed to promote the sense of presence and reduce the social distance between participants in virtual learning environments. Prior research suggests that the use of 360-degree cameras may elicit a greater perception of presence among the remote participants (Gold & Windscheid, 2020). This is in part due to the importance of the nonverbal aspects of communications that are often lost in a virtual environment. For instance, even the subtle nonverbal cues, such as the direction of gaze, can have a profound impact on human communication (Pan & Steed, 2012). This study endeavors to explore how the use of the use of 360-degree intelligent camera has affected modalities and frequencies of participation by remote and on-campus students.

STUDY PURPOSE AND RESEARCH QUESTIONS

The goal of this study was to determine whether the design of a blended synchronous learning environment, which combines an instructional approach of a protocol pedagogy framework and a technological method of using a 360-degree camera to increase visual presence, influences student interaction and experiences in the classroom. This multimethod study compared the interactions and experiences of both remote and on-campus students attending a graduate class. Quantitative and qualitative data were collected and analyzed separately. In this course, students could choose to learn remotely during one of two blended synchronous sessions. However, some students opted to learn in person for both sessions. The instructor used protocols to elicit participation. Slightly different protocols and techniques for eliciting remote participation were utilized in the second session. Data collection included survey information, field notes, and a detailed analysis of the video recordings. The overarching research questions were:

1. How do the learning experiences of on-campus and remote students compare

within a blended synchronous classroom that is designed to increase virtual presence?

2. How do instructor interactions differ with on-campus versus remote students?
3. What are the observed differences in individuals' interactions with the instructor when they attend class in different modes?

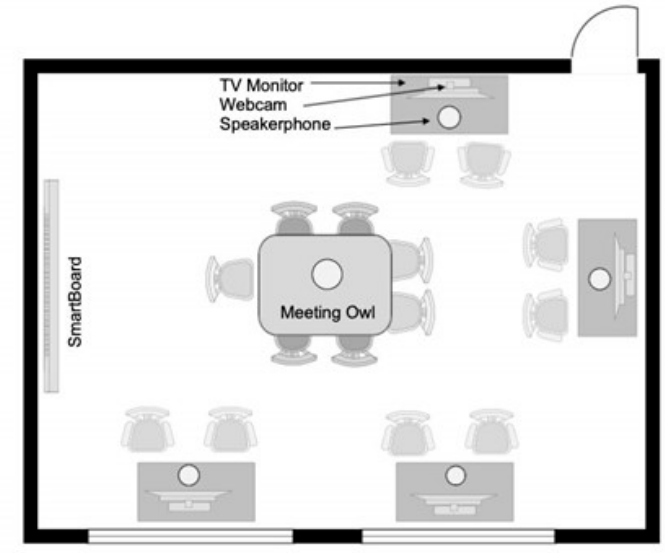
METHODS

This section explains the context of the study and the data collection and analysis utilized.

Context of the Study

The setting was an on-campus graduate seminar in an instructional design program at a Midwestern university that included nine students who alternated in their mode of attendance during these sessions. Students had no prior experience learning within a blended synchronous classroom. The nine students were broken into three groups for small class discussions. The classroom set up for the present study allowed students to meet as a full class and in small groups of two to three. Around the outside edge of the room were small table groupings that each included a computer attached to a speakerphone and a webcam. Each group's computer was assigned a breakout group within Zoom's web conferencing breakout sessions. For additional details on classroom set up, please see Authors (2019).

Figure 1. Floorplan of Blended Synchronous Classroom



A Meeting Owl 360-degree camera was purchased. This intelligent conference camera provides the remote participants with a "seat at the table" view of the on-campus students dynamically (without the need to reposition the camera). The Meeting Owl technology automatically segments the 360-video feed into three video frames of the most recent in-person speakers. This intelligent segmentation of the video feed seeks to provide remote participants with as many nonverbal cues as possible. The Meeting Owl integrates with Zoom and was situated in the middle of the room to pick up on all classroom activity during whole class discussions. When it was time for the breakout sessions to begin, the instructor moved the remote students into their respective groups within Zoom and on-campus students simply moved their seats to the small table groupings, making a seamless transition.

Data Collection and Analysis

The data collection consisted of multiple quantitative and qualitative data collection methods, including a survey, field notes capturing observations of each session, and review of recorded video sessions. Using multiple data sources allowed for triangulation of the findings, which minimizes validity issues of using a single method (Maxwell, 2013). The data sources were developed to elicit students' experiences as well as to determine if students' needs were being met (Huang et al., 2019).

Field Notes

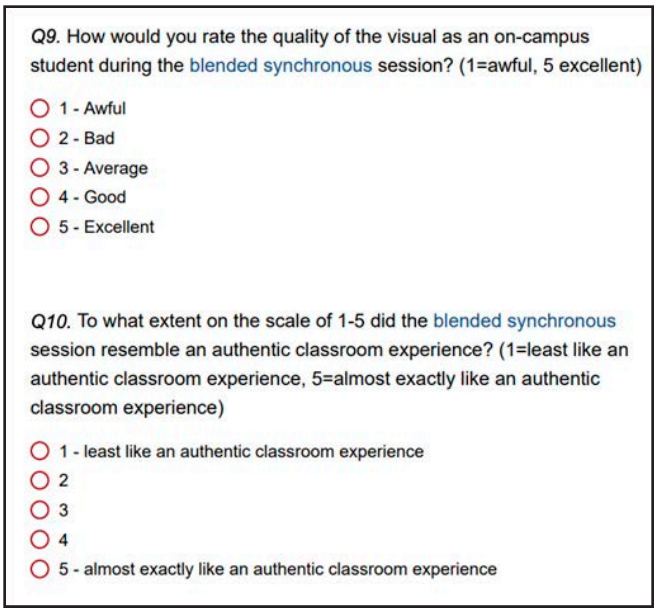
Unstructured field notes (Mulhall, 2003) were used to document the human interactions within the learning environment in real time. The style and format of field notes are often fashioned by both the study needs as well as observer habits and preferences (Mulhall, 2003). In the present study, observations were conducted by one of the coauthors not directly involved in planning or teaching the course. Mulhall (2003) suggests that an effort should be made to ensure that the observer fits into the environment of the study and does not cause undue disruption. To this end, the instructor introduced the graduate student observer to students at the beginning of each session and explained their role in the research. The observer attended two sessions of a blended synchronous class. During the first session, the observer was on campus, and during the second session, the observer participated remotely. Extensive field notes regarding human

interactions in the study environment were taken during each session. The notes were descriptive of what was happening during the class and documented who was speaking and in what mode.

Student Survey

The survey, created by the research team, was designed to assess learner experience. Survey questions asked students to rate their experiences when they were on campus versus remote, since most students had the opportunity to try out both attendance modes. Likert-scale questions asked students to rate their experiences with the video, audio, and level of authenticity of the classroom experience. Figure 2 displays two of the Likert-scale questions.

Figure 2. Examples of Two of the Likert-Scale Questions



The quantitative questions were analyzed descriptively to understand the differences between the two class experiences of the blended synchronous technology. Open-ended questions asked students about their perceived successes and challenges, as well as suggestions for improvement. For example, one of the open-ended questions was: "What challenges or difficulties did you experience during the class discussions during the blended synchronous sessions?" The qualitative data were coded to examine differential themes between the two modes of participation.

Video Recordings

The two video sessions were reviewed using a seating chart protocol (Tatum et al., 2013) with some modifications to code descriptions. In addition to these modifications, one code was removed that was not relevant, and an additional code was needed. Codes were specific to either students or the instructor. Codes and descriptions are shown in Table 1. For the original seating chart protocol, please refer to the article by Tatum et al. (2013). The student codes included call out (Vc), willingly responds (Vw), and student question (SQ). The code for raises hand (Vr) was removed since it was noted that students did not raise hands during the sessions. The instructor codes included called on (N), correction (C), follow-up (Fw), praise (Pr), and professor question (PQ). Professor question (PQ) was a code added for the present study to indicate a transition in topic or a new question. Two researchers discussed the codes and code descriptions. Each of the two researchers independently coded a section of the second session then met to discuss. They came to agreements and coded another section independently. The two researchers then met again to discuss and came to 100% agreement on coding.

The two video sessions were analyzed using the seating chart protocol in Table 1. Two students who attended remotely during the first session and on campus for the second session were selected in order to compare individual interactions based on mode of attendance. Analysis of the second video provided data on the overall interactions between the students and instructor.

RESULTS

Field Notes from Observations: On campus and Remote

In order to document different perspectives on the classroom, observations were recorded once on campus and once from a remote location. There were no issues with the underlying technologies from the perspective of the on-campus or remote observations.

On-campus observations (Session 1)

The instructor arranged classroom furniture in advance to ensure optimal layout. All equipment was prepositioned in advance by the instructor. As students entered the classroom, the instructor

Table 1. Modified Seating Chart Observation Protocol (modified from Tatum et al., 2013)

Student Codes	Behavior	Modified Description
Vc	Call out	Student interjects at any time
Vw	Willingly responds	Student responds to a teacher call on (such as a request for responses or a protocol)
SQ	Student question	Student asks a question

Instructor Codes	Behavior	Modified Description
N	Called on	Professor requests responses
C	Correction	Professor corrects a student response or misunderstanding
Fw	Follow-up	Professor makes a follow-up statement. May include a short praise but adds more than that
Pr	Praise	Professor gives praise to a student
PQ	Professor question/Topic transition	Professor asks a prepared question or transitions to a new topic

directed them to their seats. At the beginning of the class, the instructor welcomed both on-campus and remote students to the classroom and provided a brief tutorial on the key features of the video conferencing software. Students (both on campus and remote) spent a significant part of the class in discussion breakout groups. One on-campus student noted:

> *I liked it; I thought it was pretty interesting. I thought at first that it would be really difficult to break into small groups, but once you got started talking, it felt like we were in a small group and not overwhelmed with what everyone else was doing.*

In the break-out sessions both the on-campus and remote students were actively engaged, demonstrated by talking with other students and completing activities as a group. However, during whole class debriefs, remote students appeared to take a more passive role as compared to the on-campus participants, such as waiting to speak until they were called upon.

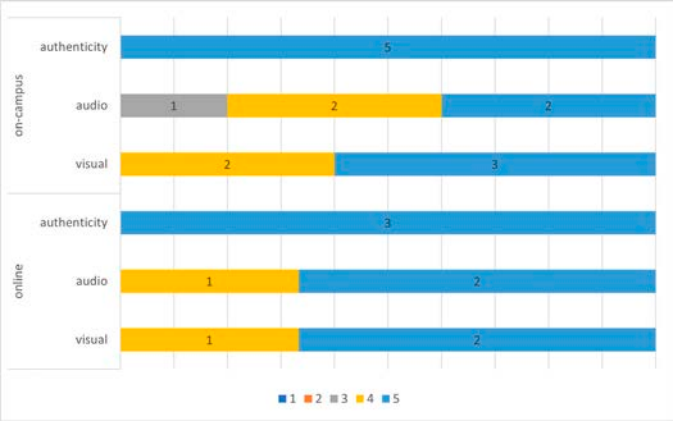
Remote observations (Session 2)

During the second session, the graduate student observer participated remotely. The instructor provided brief guidance on the use of technology to students at the beginning of the class, like the first session, except that the instructor explicitly encouraged remote students to participate proactively in class discussion. When remote, the observer had no difficulty following the on-campus discussion. The ability to see up to three of the most recent on-campus speakers on the screen helped the remote observer to pick up on the nonverbal clues. During the second session remote students appeared to engage more during the whole class discussions. This was evidenced by the remote student's willingness not only to jump into unstructured discussion organically, but also by their ability to recognize and address the perceived tentativeness of their audience by further elaborating on their original statement without prompting.

Survey Findings

Five students responded to the survey after the second session. Given the small sample size, statistical differences could not be calculated. However, the median ratings indicated that students, whether they were remote or on campus, had similar experiences with the visual (Mdnon-campus = 5.0; Mdnremote = 5.0) and audio (Mdnon-campus = 4.5; Mdnremote = 5.0). When students were on campus, they rated authenticity, the extent to which the blended synchronous session resembled an authentic classroom experience (Mdnon-campus = 5.0), a little higher than when they were remote (Mdnremote = 4.0). However, it is notable that all ratings were above 4.0 out of 5.0 on all Likert-scale questions from the student survey. Figure 3 shows the distribution of scores for each Likert scale question. For example, all five students rated the authenticity of the classroom experience as a 5; however, for the quality of audio, there was more variability: one student rated it as a 3, two students rated it as a 4, and two students rated it as a 5. (Note: 3 of the 5 students responded to the online questions.)

Figure 3. Distribution of Scores for Each Likert Scale Question



Several themes were noted in the open-ended survey responses. The most prevalent theme was that there was a learning curve associated with participating in this new type of environment. Most students commented that as they became more familiar with the technology the experience felt smoother and more authentic. For example, one student noted "People were more familiar with the controls, which allowed for more seamless integration with the students joining remotely. The less technology troubles there were, the more authentic the classroom experience was." Another student expressed a similar sentiment: "I feel we are still getting used to the technology. However, when it is working correctly, all goes well." One suggestion related to this theme was to allow students to have more time to become familiar with technology.

The next most common theme that emerged from the data is that the students felt that they had an equivalent experience regardless of what mode they attended in. For example, one student noted: "the technology use was equivalent to a normal classroom setting." Other students commented that it did not feel like there was a distance between students who were not in the classroom. For example, one student reported: "it was making [me] feel, that my friend was sitting beside me."

Although generally students were very positive about the experience, there was a common theme around communication issues. For example, one student mentioned: "Sometimes it was hard to hear the people talking when in a large group." Other students noted that they felt less comfortable communicating when they were participating remotely. For example, one comment was, "I felt less inclined to speak when I was joining online, so I felt more comfortable when I was given the opportunity to talk rather than have the expectation to talk."

While not as prevalent as the above themes, several students commented on the convenience of working from home. For example, one student mentioned:

> *Since I was joining in from my computer at home, I could spread out all of my materials across my home desk and computer. I found it easier to reference information in my own space at home versus a shared space in the classroom.*

Participating remotely not only has the benefit of not having to commute in, but also the convenience of working in the home environment.

Video Analysis using a Seating Chart Protocol

Two analyses were performed based on the recorded sessions. The first analysis was to compare two students who attended the first session remotely and the second session on campus. The second analysis compared overall remote and on-campus responses as well as instructor responses in the large group discussions. The second analysis used the recorded video from the second session. The first session did not include video of the classroom, only video of the presentation and remote students. Therefore, only the remote students could be coded in the first session. The second session included video of the classroom and on-campus students as well as the remote students, which allowed all student and instructor interactions to be coded.

Individual Comparison by Modality

For the first analysis, two students were selected and their responses in both video-recorded sessions were coded based on the seating chart protocol. These two students, Ryan and Andrea (pseudonyms), attended the first session remotely and the second session on campus. Ryan and Andrea's responses by session are found in Table 2. Ryan had a total of seven responses while attending as a remote student in session one and thirteen responses as an on-campus student in session two. As a remote student, four (57%) of Ryan's seven responses were prompted responses due to a call on (N), such as a professor question (PQ) that included a discussion protocol or a request for responses from the instructor. On the other hand, Ryan responded 13 times in the on-campus session with only one (8%) reply in response to a call on.

Table 2. Responses by Same Students Across Mode

	Total Responses during Group Discussions	Willingly Responded	Response to a Call On	Percent Prompted Responses
Ryan				
Session 1	7	3	4	57% (4/7)
Session 2	13	0	1	8% (1/13)
Andrea				
Session 1	4	0	4	100% (4/4)
Session 2	2	0	2	100% (2/2)

Table 3. Descriptive Statistics by Mode

Student Codes	On Campus Students (n=6)			Remote Students (n=2)		
	Total	*Mean*	*SD*	*Total*	*Mean*	*SD*
Vw	8	1.33	0.47	5	2.5	0.5
Vc	46	7.67	5.76	7	3.5	1.5
SQ	1	0.17	0.37	3	1.5	0.5
Total	55	9.17	6.23	15	7.5	2.5

The second student, Andrea, had four responses as a remote student and all (100%) of her responses were related to a call on (N). Andrea had two responses as an on-campus student in the second session with 100% of these replies also in response to a call on (N) by the instructor.

On Campus and Remote Responses Overall

The second video analysis focused solely on the second recorded session. Eight of the nine students were present for this session: two attended remotely, six students attended on campus, and one student was absent. Student and instructor responses were coded and tallied.

Descriptive statistics for student observations were calculated and are shown in Table 3. Overall, on-campus students had a greater number of total responses compared to remote students. Mean responses for willingly responds (Vw) and student questions (SQ) were higher for remote students. However, the mean responses for call outs (Vc) were higher for on-campus students.

A total of 70 responses were provided by students with 78.6% of responses coming from on-campus students (n = 6) and 21.4% of responses coming from remote students (n = 2). Table 4 includes the frequencies of responses based on code type and the total responses. The majority of responses for both on-campus and remote students were call outs, 81.8% and 53.3%, respectively, in response to a professor question or call on from the instructor.

Instructor Statements

The instructor spoke a total of 55 times to introduce a topic or respond to students, including eight called ons (N), three corrections (C), 19 follow ups (Fw), 19 praises (Pr), and six professor questions (PQ). Table 5 lists the frequencies of instructor codes and which group the response was directed toward, either on-campus, remote, or both groups. Thirty of 55 responses (54.5%) were directed toward on-campus students only. Sixteen responses (29.1%) were directed toward remote students and nine responses (16.4%) were directed toward all students. Notably, the instructor called

Table 4. Frequency of Responses by Code and Total Responses

Mode of Attendance	Vc		Vw		SQ		Total Responses by Attendance Mode	
	n	%	*n*	%	*n*	%	*n*	%
On Campus Students (n=6)	45	81.8	9	16.4	1	1.8	55	78.6
Remote Students (n=2)	8	53.3	4	26.7	3	20	15	21.4
Total (n=8)	53	75.7	13	18.6	4	5.7	70	

Table 5. Frequency of Instructor Responses to Students by Mode

Instructor Codes	On-Campus		Remote		Both		Total by Code Type
	n	%	*n*	%	*n*	%	
N	0	0	5	62.5	3	37.5	8
C	1	33.3	2	66.7	0	0	3
Fw	14	73.7	5	26.3	0	0	19
Pr	15	78.9	4	21.1	0	0	19
PQ	n/a	n/a	n/a	n/a	6	100	6
Total by Attendance Type	30 (54.5%)		16 (29.1%)		9 (16.4%)		55

on (N) students eight times: five of these were directed toward remote students only and three were directed at both remote and on-campus students. Overall, the most responses were directed at on-campus students, which is related to the greater number of students present on campus versus remotely and the greater number of interactions from on-campus students.

DISCUSSION

Comparison of Learning Experiences of On-Campus and Remote Students

Video analysis, field notes of observations, and surveys provide insight into the learning experiences of on-campus and remote students. The findings indicate the importance of encouraging remote student participation, an increase in student engagement over time, and the equivalency of remote and on-campus experiences.

Remote students need encouragement to increase their engagement and participation in the class. Raes et al. (2020), in their systematic review, noted that engaging remote students was a challenge in blended synchronous education. Even in small class sizes, remote students often feel like spectators or outsiders (Lakhal et al., 2020; Olt, 2018). Distributing attention to in-person and remote students can be challenging for instructors because of the level of multitasking required in

these types of environments (Zydney et al., 2020). Although incorporating the 360-degree camera in this study helped to reduce some barriers in on-campus/remote student communication, the instructor also needed to explicitly encourage remote students to join in the discussion. With prompting, remote students were able to seamlessly join in the discussion without any turn-taking issues. Even though on-campus students had more responses overall, video analysis showed that remote students still actively participated in class, most often willingly responding to the instructor. This contrasts with previous research that indicated low participation from remote students despite instructor attempts to engage students (Conklin et al., 2019). To overcome this tendency, the instructor in the present study asked questions of the entire class to prompt responses, called on students to contribute, and included protocol-based discussions to encourage active participation. These techniques have been used in prior research. For example, Conklin et al. (2019) also reported that the instructor asked questions of the entire class or called on students directly, which helped improve students' perception of equal instructor attention between remote and on-campus students, although this approach still resulted in lower frequency of participation of remote students. Zydney et al. (2020) found that incorporating protocols provides a clear purpose for discussion and creates more equitable participation.

In addition to student encouragement, more exposure to the blended synchronous classroom can improve engagement. As noted during the live observation, students had increased engagement during whole group discussions in the second session compared to the first session. However, the students who attended remotely differed in each session; therefore, further research is needed to learn more about repeated exposure to the same attendance mode when using blended synchronous experiences.

Student feedback and survey responses provided additional information about student experiences in the blended synchronous classroom, indicating similarities. For example, an on-campus student noted the easy discussion that occurred in small mixed groups. Data from the student survey showed that audio and visual experiences for remote and on-campus students were similar. Unlike previous research by Wang et al. (2017), remote students were able to see the instructor and the on-campus classmates due to the 360-degree camera. The camera offered multiple views and focused on the person speaking. However, on-campus students ranked authenticity of their classroom experience slightly higher on the survey. One student mentioned in their survey that they were less comfortable speaking when remote. Futch et al. (2016) described "comfort" as a mediator for student success in blended learning. Students who are more comfortable are more willing to try (Futch et al., 2016). Although Futch et al. (2016) defined blended learning as a combination of face-to-face and online tasks, comfort is also a factor in participating in blended synchronous learning. Students may participate more frequently when they are comfortable in the learning environment.

Differences in Instructor Interactions with On-Campus versus Remote Students

This study showed that interactions with the instructor differ between on-campus and remote students. In the present study, most statements from the instructor were directed toward on-campus students, this includes follow-up responses as well as praising students. This is related to the larger number of responses from on-campus students overall. The instructor had to call on remote students directly or prompt them to elicit more responses. Conklin et al. (2019) found that most interactions were on-campus, student-instructor interactions. Even though remote students felt that communication was equal, frequency counts showed that the instructor interacted more with on-campus students (Conklin et al., 2019). Communication is often a concern in the blended synchronous environment and the instructor must be aware of both remote and on-campus students (Bower, Kenney, et al., 2014). Instructors can be successful with blended synchronous learning by being well prepared with course materials and technology and prompting students to prepare for class (Bower, Kenney, et al., 2014; Bower et al., 2017).

During the second video session, there was one point in which the instructor did not acknowledge a comment made by a remote student. This incident was not the norm for the sessions, but prior research has found that instructors may not pay full attention to remote students (Wang et al., 2017). However, the occasional missed comment is possible in any situation, either remote or on campus.

Differences in Individuals' Interactions with Instructor Based on Attendance Mode

The findings from this study indicate that individuals have different interactions with the instructor when they attend a class on campus versus remotely. Observing video recordings and counting responses of individual students in different modes of attendance showed that one student could have a different number of interactions depending on their mode of attendance. When remote, most student responses were prompted in response to a protocol or being called on by the instructor. However, the number and type of responses can be different among individuals. The difference in total number of responses between the two students indicates that other factors, such as personality or comfort, may play a role in responding. As found previously, prompted replies such as in response to protocols or being called on by the instructor, may help to increase remote student participation, especially for those students who are less likely to speak out (Zydney et al., 2020).

CONCLUSION

Blended synchronous learning allows students to attend in different modes, either on campus or from a remote location. Instructors and course designers should consider the technical and pedagogical implications when using blended synchronous learning. The classroom design, arrangement of equipment, and camera choice all impact the blended synchronous experience. Utilizing protocol-based discussions can increase student interactions and improve the learning experience for both on-campus and remote students. Blended synchronous learning involves planning to ensure authentic experiences for remote and on-campus students. Instructors should ensure audio connections are clear for remote students and consider camera options that allow both remote and on-campus students to have an authentic classroom experience. Extra time spent planning the classroom layout and technology means a more interactive experience for all students. In addition to technology, instructors and course designers must plan for the flow of each class and maximize educational tools to connect remote and on-campus students. For example, establishing norms enables remote students to feel more comfortable jumping into the conversation. With norms, students are familiar with expectations and can participate with more comfort. Discussion protocols also lessen the pressure that students may feel or discomfort when trying to respond. Instead, students are actively engaged by following the rules for interaction prompted by the protocol.

One major limitation of this study is the small sample size both in terms of students as well as instructors. This study only included the students in one instructor's course. Additionally, only the second session could be fully analyzed using the seating chart protocol since the first session did not record on-campus students or the instructor. The findings also included only whole class discussions as opposed to small group discussions since the small group sessions could not be recorded. Future research could focus on the small group discussions and the interactions between remote and on-campus students within small groups. A key future direction would be to explore ways of promoting nonverbal communication throughout all phases of a blended synchronous course to enhance the student experience.

This study was conducted prior to the COVID-19 pandemic. The COVID-19 pandemic has affected traditional teaching and learning. As students were sent home from campuses, educators turned to remote learning. The time during the pandemic has demonstrated that there is a need for well-designed education methods beyond the traditional face-to-face classroom. Even as students returned to campuses, blended learning and hybrid models were still needed for students who need to miss class. As educators must rethink their mode of delivery due to the COVID-19 pandemic, research on larger classes is also needed. Protocols could also be studied in larger classes to better understand their use. In large classes, protocols could be used in group work to ensure equal presence for students. A larger class size would allow for comparison groups and more quantitative data for support.

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