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Investigation of Technology-based Student Interaction for Social Learning in Online Courses

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Abstract

This work in progress research paper studied the use of technologies, platforms, and methods for interactions during the course and outside the course by the engineering students enrolled in the summer 2020 semester at a large Southwestern public research university. In March of 2020, this university migrated away from face-to-face teaching, like other institutions, in response to the COVID-19 pandemic. This migration resulted in the development of synchronous (remote) and asynchronous (fully online) courses that were offered to students through the remaining Spring and also the Summer semester of 2020. Previous studies have shown that student and faculty interaction along with student-student interaction have a net positive effect on student retention and learning. This study was designed to identify the tools—technology or platforms—and methods used for interaction in the summer 2020 courses. All students enrolled in engineering courses in summer 2020 were invited to take part in the survey. However, 315 students started the survey and only 93 respondents completed the survey fully. While there are useful data from the entire starter group, this study looked at the data generated by the 93 respondents who completed the survey. The student responses indicate that most faculty, whether teaching synchronously or asynchronously, supplemented their courses with some technology or platform that facilitated live interactions (Zoom, Google Meet, Blackboard Collaborate, Microsoft Teams). Even though the students were moderately satisfied with the technology/platforms and methods that were used, they showed a higher degree of satisfaction for courses that used active learning and other methods for student engagement. For social learning, the students used GroupMe, text messaging, or Zoom calls to interact with each other outside of class.

I. Introduction

In March 2020, the college of engineering in a large university in the southwest was required to migrate all teaching to technology-enhanced formats without the face-to-face class meetings due to COVID-19 related closures. As a response to the closures, all the courses were forced to rapidly migrate to an online or remote teaching/learning environment in order to mitigate the effects of the COVID-19 pandemic. This rapid change in teaching and learning modalities caused disruptions in the learning cycles, which lead to the development and adoption of various mitigation strategies. To facilitate this rapid transition to technology-enhanced formats, the institution suspended classes for a week and held a variety of workshops and hands-on events for faculty to help them with the adoption of technologies and pedagogical solutions to provide academic continuity for the remainder of the spring 2020 semester. This rapid migration in spring was partly successful as borne out in faculty and student surveys, but there was also the realization that a large part of the success was due to the rapport-building activity that had already occurred in the 6-8 weeks before the start of the pandemic-related closures. Subsequent student surveys toward the end of April indicated that while the students had a great appreciation of the efforts undertaken by faculty in ensuring semi-uninterrupted learning, the students

indicated that they missed interactions. Very early studies have shown that student interaction is key to their success in courses. Chickering and Gamson [1] consider 5 of their seven principles to be keys for interaction and 2 among those five deals with faculty to student and student to student interactions. Delving into this issue of interaction led to the discovery that students not only missed the interactions they were used to having in courses, but also missed their social interaction related to learning such as a serendipitous formation of informal study groups, social learning opportunities, and other such interactions.

Research has shown that student engagement in online courses is key to success. Given the short nature of the transition to technology-enhanced teaching, this preliminary study identifies the typical tools, platforms, and methods (methods are pedagogies for this study) used by faculty to engage with the students in their asynchronous and synchronous courses. In this study, synchronous courses are defined as courses where the students and instructors are required to be online in real-time (Remote course taught via videoconferencing is an example of this kind of course), and asynchronous courses are those courses where instructors and students are required to be online, but not in real-time. There may be real-time requirements such as office hours or recitations, but a majority of the course is not real-time (a pre-developed online course is an example of an asynchronous course). Additionally, we will provide the tools and methods that the students used to communicate with other fellow students outside the class session which may give additional insight into the tools used for social presence and learning.

II. Background

Theoretical Background

Numerous studies have shown that student interactions in online and technology-enhanced courses, in general, are critical to student retention and success. Early work by Moore [2] introduced the idea of transactional distance which posits that learning is a transaction between the instructor and learner, and when the geographic distance between the instructor and students increases such as in online and remote learning, learning efficacy can only be achieved by increasing the levels of interaction, which in effect plays the role of reducing the transactional distance. Other research by Garrison et al. [3][4] measured cognitive, social, and teaching presence which are all forms of interaction, and show their combination to be a necessity in effective learning. Bernard et al. [5], among others [6][7][8] show the strong correlation of student-content and student-instructor interaction to heightened learning outcomes. They also show that student-student interaction can be a contributory factor to student retention and learning.

While interaction in courses and their importance in student engagement is necessary, other studies have shown the value of social interaction and informal networks, as a necessary part of learning [9][10][11][12]. Bandura's social learning theory posits that there is a large component of social engagement that plays a role in cognition and learning. These informal engagements that happen by the formation of informal study groups, social structures outside the classroom are some examples of spaces where students engage in information exchange. These informal exchanges are important to engender in technology-enhanced learning to ensure that the students have opportunities for developing informal engagement and space.

Purpose of Study

Given the rapid transition to remote and online learning formats, we developed a study to investigate the tools (technologies and platforms), and methods used by faculty to engage with students in asynchronous and synchronous learning. In addition, we planned to gain an understanding of how students adopt technological tools to keep some continuity in their informal and social learning networks, so we also surveyed the students to identify the technology, platforms, and methods they use to communicate with each other outside of class hours. Finally, we asked the students about their experiences in their face-to-face courses in the semester before the pandemic. We will explore any differences in satisfaction with technologies, platforms, or methods between the synchronous and asynchronous courses, and identify tools and methods that may play a role in student satisfaction and learning.

III. Method

Participants

The participants were students enrolled in engineering courses in the summer of 2020. This group was identified by running a report on summer courses, and the invitation with the survey was sent by the administrative office in charge of student affairs in engineering. While 315 students started the survey, but only 93 students (henceforth referred to as participants) completed the survey fully. While the rest of the survey data do provide some insight, we chose to only use data from students who finished 100% of the survey to ensure completeness in our reporting. Table 1 shows the demographics of the participants.

Table 1: Demographics of participants

Classification			
#	Answer	%	Count
1	Freshman/First-year	1.08%	1
2	Sophomore	3.23%	3
3	Junior	27.96%	26
4	Senior	54.84%	51
5	Masters	5.38%	5
6	Doctoral	7.53%	7
	Total	100%	93
Gender			
	Male	53.76%	50

	Female	46.24%	43
Ethnicity			
	White	60.22%	56
	Hispanic or Latino	13.98%	13
	Black or African American	5.38%	5
	Asian	16.13%	15
	Multi-racial	4.30%	4

Measures

An online survey was constructed to probe the kinds of classes (synchronous, asynchronous, or mix of synchronous and asynchronous) the students were taking. We first built the survey and administered it to a small focus group to ensure that the language was understood by the students, and we were collecting the correct data. The initial feedback indicated that the students understood the differences between technology/platforms and methods, but they also indicated a preference for not being boxed by fixed responses. This led to the creation of a survey that was largely open-ended in a bid to fully capture the experiential information.

The final survey consisted of 7 blocks or sections. The initial two blocks were the informed consent and demographic blocks, followed by 5 blocks that in turn solicited a response to queries about technologies/platforms used in synchronous and asynchronous courses, methods used in synchronous and asynchronous courses, and methods used in equivalent face-to-face courses in the previous semester (fall 2019). In addition, we solicited information about their technology use to connect with other students outside of class, since this would be a good measure of their attempt at maintaining their social learning networks. The survey that was used for this study is discussed in [13].

Data analysis

Descriptive statistical analyses were applied for frequency data, such as counting of the tools that were identified in the synchronous and asynchronous sections of the survey. In addition, we identified common themes that appeared in the open responses in all blocks of the survey. We also conducted subgroup analyses by gender, ethnicity, and first-generation status of the respondents.

For open-ended responses, inductive analysis and a creative synthesis strategy were employed to analyze the responses [14]. First, the researchers independently identified the themes that emerged in the data and coded the data based on their identified themes independently. Second, they held occasional meetings to reach a consensus on their independently identified themes. Third, they coded the data independently again based on the consensus themes, and then compared, discussed, and re-coded until they reached a consensus on all of the coding. Finally, they labeled and described the themes and calculated the frequency of each theme as it appeared in student's raw responses. The frequency data were then converted to the percentage of students who responded with each theme, which will be discussed in the future paper.

IV. Results

The data from the respondents who completed the survey indicates that most of them took asynchronous courses instead of synchronous courses (Figure 1). Table 2 shows the type of courses taken by student classification. This seems to indicate that asynchronous courses were more popular to take than synchronous courses. While there is a chance that this trend might be based on the only available delivery mode, the examination of enrollment data indicates that when the same course was offered in asynchronous and synchronous modalities, the asynchronous course filled up faster and showed a higher enrollment than synchronous course. Further, the students in higher classifications preferred asynchronous courses.

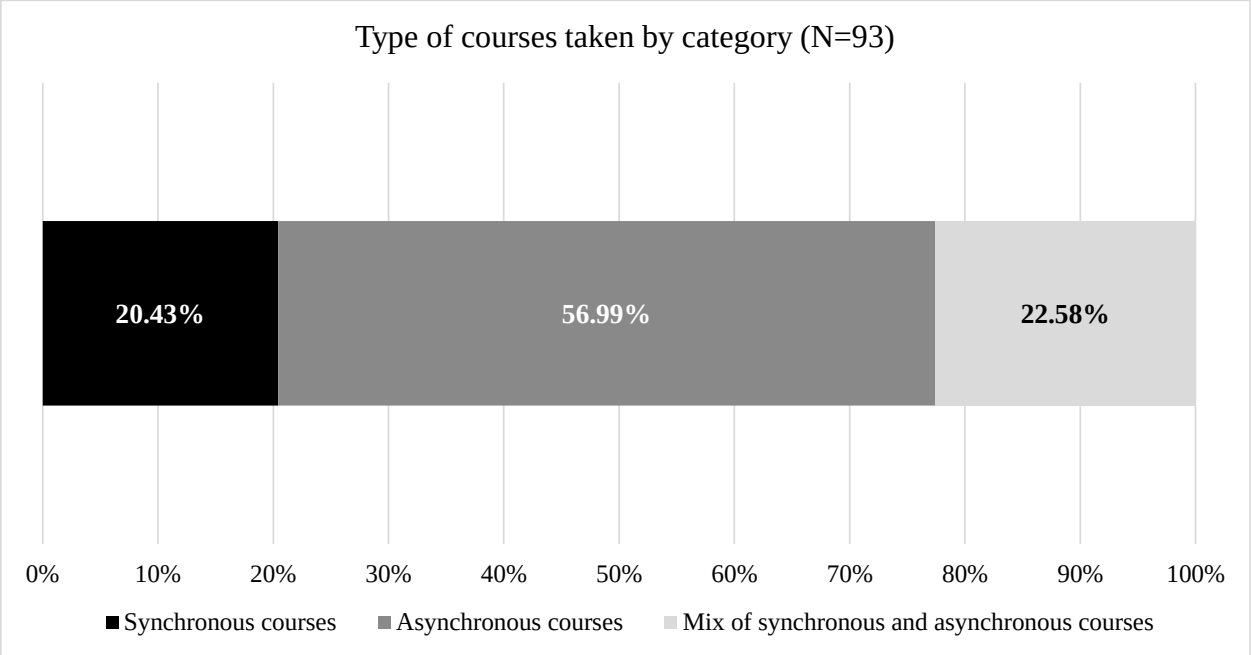

Figure 1: Types of courses taken by category (N=93)

Table 2: Types of courses taken by respondents' student classification

	Freshman/ First-year	Sophomore	Junior	Senior	Masters	Doctoral
Total Count (Answer)	1	3	26	51	5	7
Synchronous courses	1	1	6	11	0	0
Asynchronous courses	0	0	14	30	4	5
Mix of synchronous and asynchronous courses	0	2	6	10	1	2
Synchronous courses	100.0%	33.3%	23.1%	21.6%	0.0%	0.0%
Asynchronous courses	0.0%	0.0%	53.8%	58.8%	80.0%	71.4%
Mix of synchronous and asynchronous courses	0.0%	66.7%	23.1%	19.6%	20.0%	28.6%

Synchronous courses

The data from students indicate that most faculty tended to use Zoom for their content delivery for synchronous courses. There were instances where faculty supplemented their courses by using eCampus (Blackboard) as a supportive tool when the students were not in the live session. In some cases, Piazza which is a dynamic discussion platform with some learning management system-like features built-in was also used for course supplementation or delivery. Further, Google Meet was also used for video communication during the online session. It is important to note that many students responded with a combination of tools that were used in their course, even though each tool has been shown separately in Figure 2.

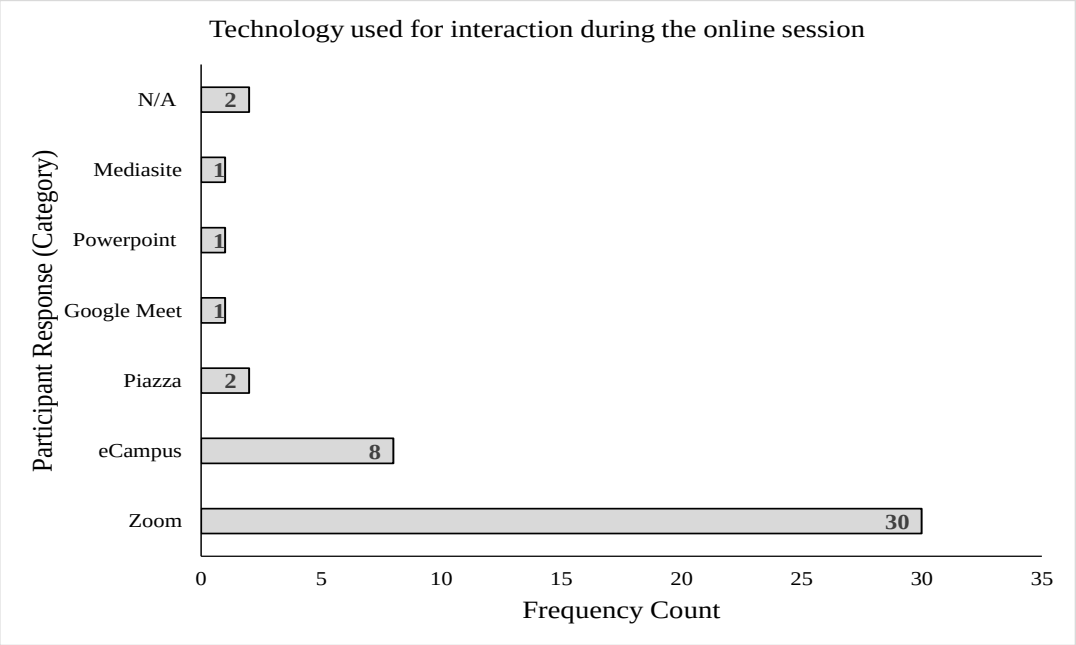

Figure 2: Technologies used for interaction during the online session of synchronous courses

In terms of methods, Figure 3 provides the most common methods used by faculty including the live lecturing methods, followed by active learning, and live interactive lecturing. The live lecturing methods in the synchronous session were in the form of a slides presentation or instructor writing notes over the videoconferencing call. Even with the live lecturing methods, the students relied on asking questions to interact with the instructor using text or voice, and group work for collaboration and discussion to interact with other students during the course time.

From the student responses, active learning included annotation/diagramming, group work and discussion, voice and text chat, or polling and quiz activities. The live interactive lecturing methods included a combination of the live video stream and the use of chatbox or discussion boards at the same time.

From Figure 4, there is an indication that students were somewhat satisfied with the technologies/platforms and methods used by instructors/TAs during the online session. Filtering the data by type of methods and satisfaction indicates that students showed the greatest satisfaction when live lecturing methods were supplemented by students being able to ask questions from the instructor during the session, at the end of the session, during office hours, or by email after the session.

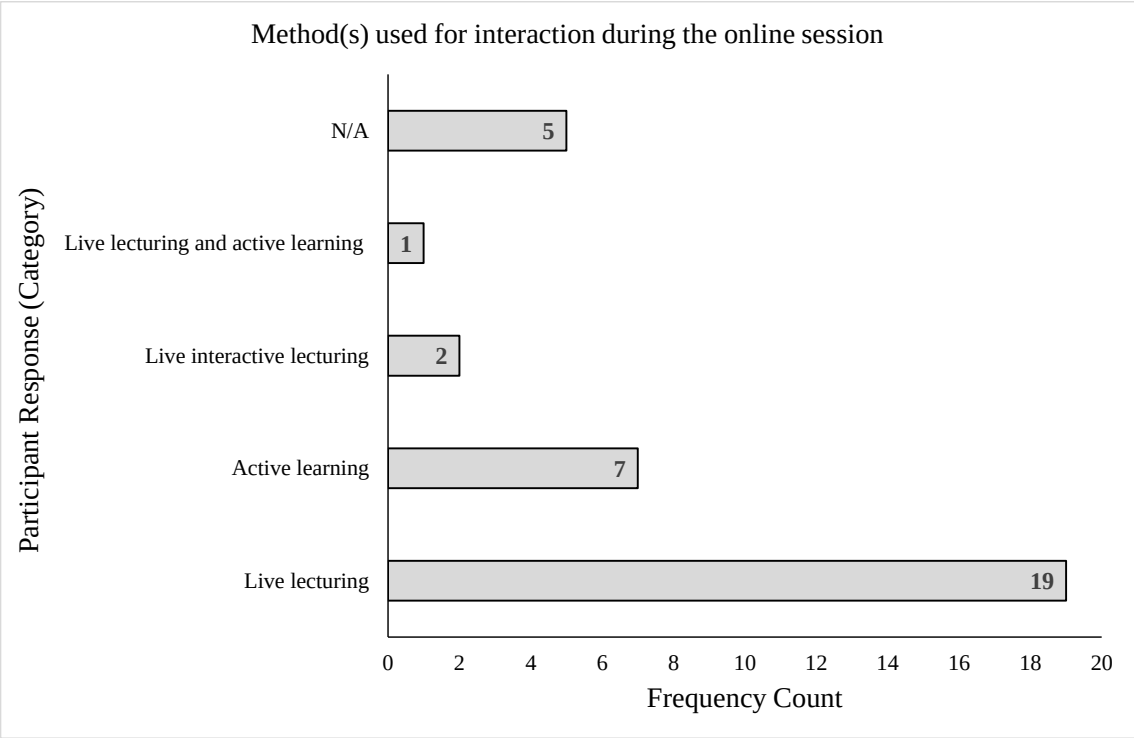

Figure 3: Methods used for interaction during the online session of synchronous courses

How satisfied are you with the technology/platforms or methods that you used for interaction with instructors/TAs during the online session?

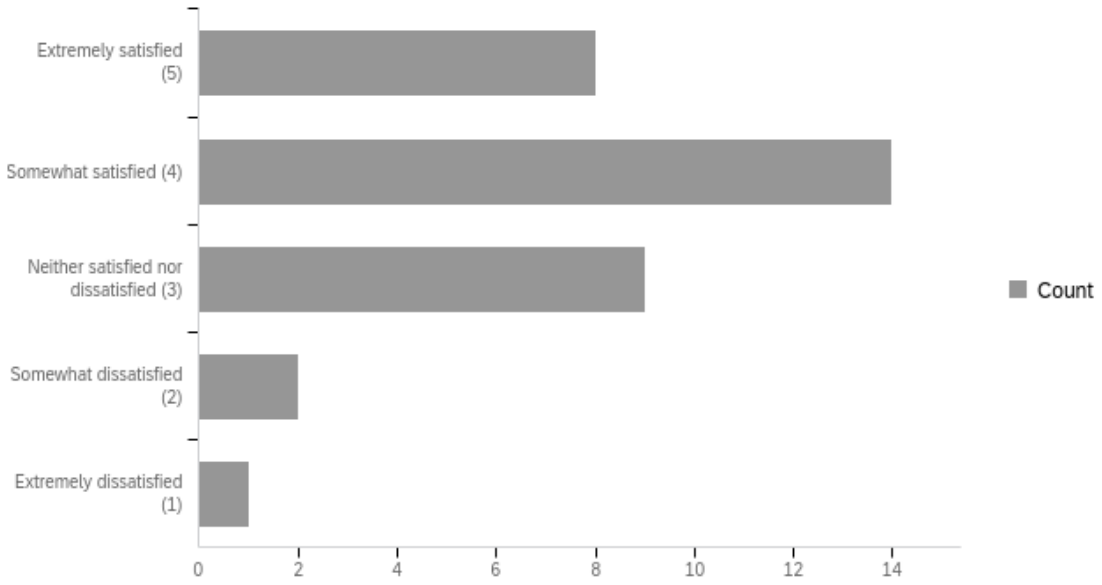

Figure 4: Satisfaction with technology, platforms, or methods used for interaction with instructors/TAs during the online session of synchronous courses

In the synchronous online session, the students interacted with instructors/TAs for 3.5 ± 6.2 hours on average per week (Table 3). Half of the students spent at least 2 hours per week in online sessions interacting with the instructors/TAs.

Table 3: Time spent (number of hours per week) in interaction with instructors and TAs during the online session

Interaction in hours/week with instructors/TAs	
Mean	3.5
Std. dev.	6.2
Median	2
Mode	3

Asynchronous courses

Analysis of the data related to asynchronous courses indicates that a wider variety of technologies or platforms were used by faculty for their asynchronous teaching (Figure 5). The most common tool was eCampus (Blackboard), and in a similar arena as a learning management system were tools like Piazza, Google Sites, and Canvas. It was interesting to note that faculty used Zoom as a tool for synchronous engagement besides just having pre-built videos and modules for the asynchronous courses. It is important to note that many students responded with a combination of tools that were used in their course, even though each tool has been shown separately in Figure 5.

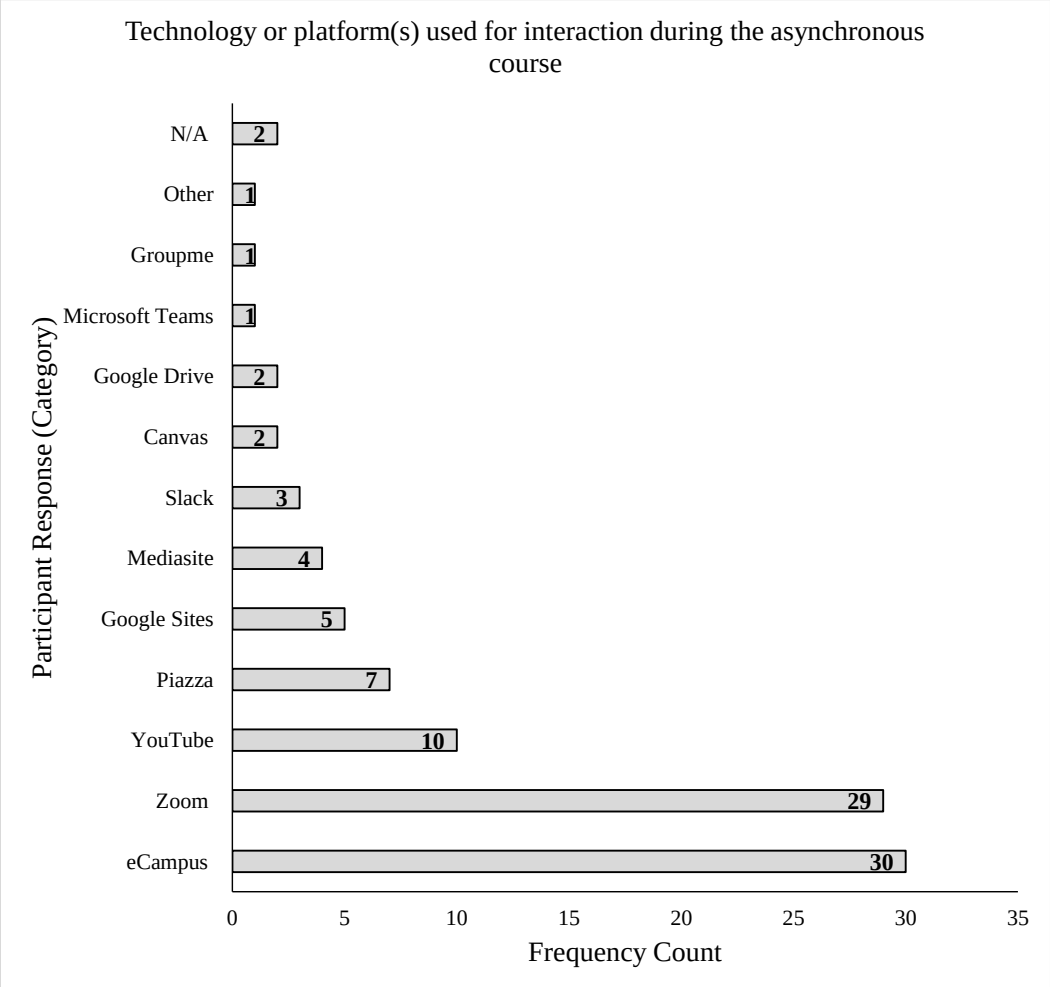

Figure 5: Technologies used for interaction during asynchronous courses

Figure 6 provides the most common methods used by faculty including the recorded videos, followed by live interaction, learning management systems (LMS), and email. Some faculty also used annotation in recorded video, or messaging methods during asynchronous courses. The recorded videos for the asynchronous course were in the form of pre-recorded lectures shared using Zoom, YouTube, or another platform. With the recorded video methods used by the instructor, the students relied heavily on asking questions during virtual office hours/meetings (live interaction) or by email to interact with the instructor, and live video calls or messaging apps (e.g., GroupMe) to form study groups with other students during the course. From the student responses, the use of the learning management system method included file-sharing or discussion forums during the course.

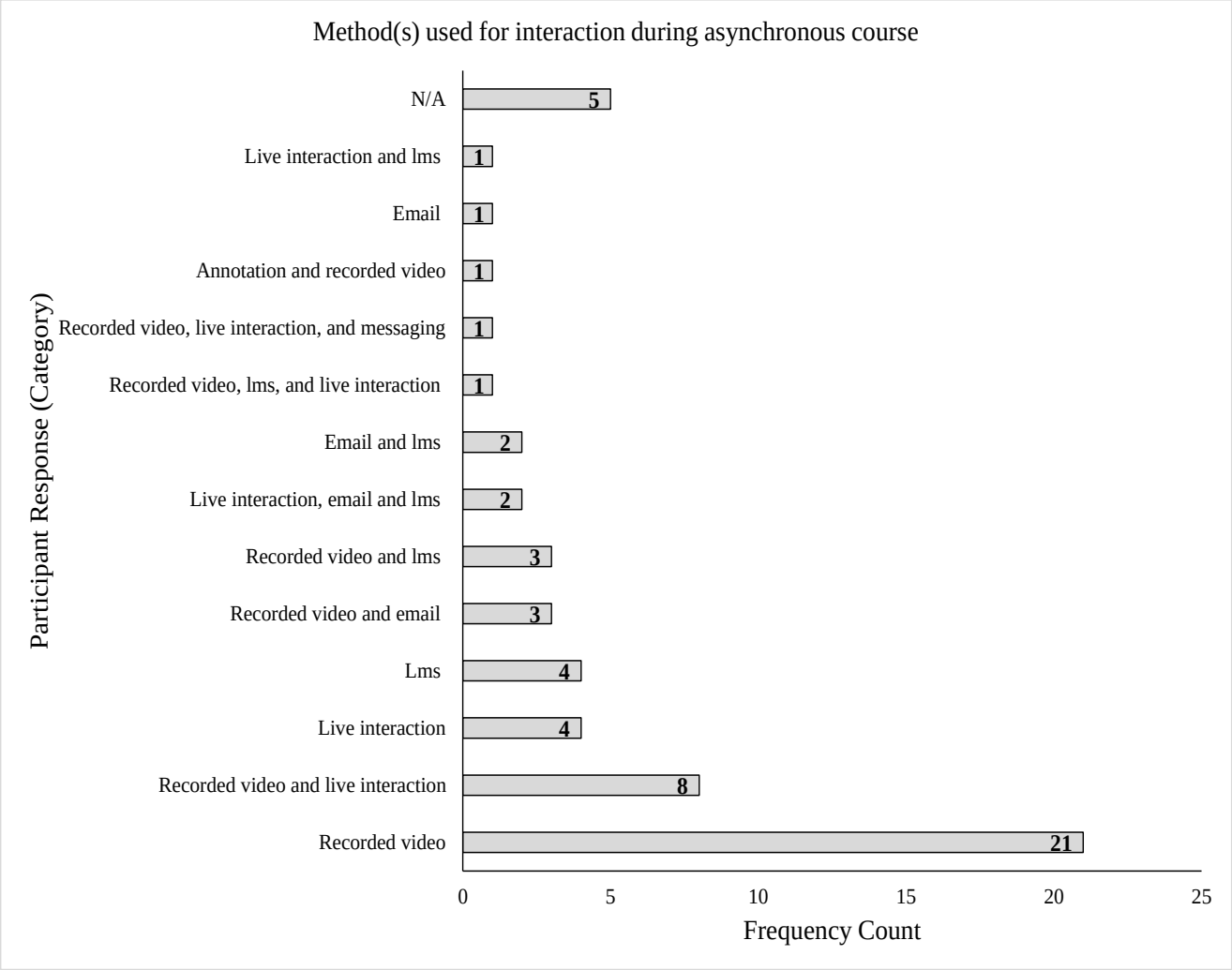

Figure 6: Methods used for interaction during asynchronous courses

According to Figure 7, the students were somewhat satisfied with the technologies/platforms and methods used by instructors/TAs during the asynchronous course. Filtering the data by type of methods and satisfaction indicates that students showed the greatest satisfaction when recorded videos were supplemented with live interaction (office hours and meetings) and students having email communication with the instructor.

How satisfied are you with the technology/platforms or methods that you used for interaction with instructors/TAs during the course?

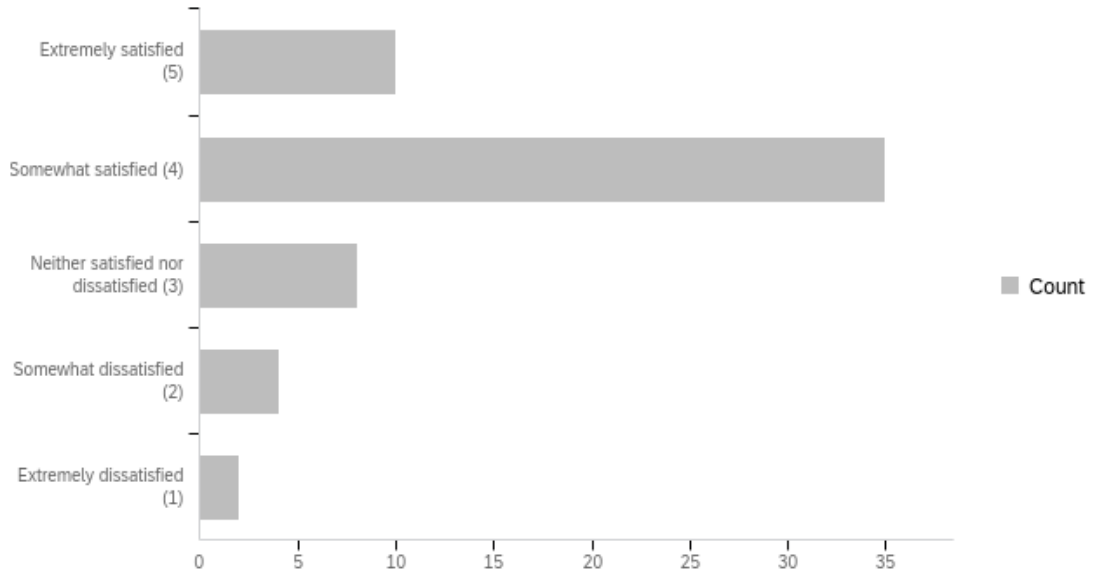

Figure 7: Satisfaction with technology, platforms, or methods used for interaction with instructors/TAs during the asynchronous courses

In addition, table 4 shows that the students spent on average 2.9 ± 4.4 hours per week interacting with instructors/TAs during the asynchronous course. Half of the students spent at least 1 hour per week during the course interacting with the instructors/TAs.

Table 4: Time spent (number of hours per week) in interaction with instructors and TAs during the asynchronous course

Interaction in hours/week with instructors/TA	
Mean	2.9
Std. dev.	4.4
Median	1
Mode	1

Technologies used for social learning

For social or informal learning, the survey also asked students about the technologies or platforms they used outside of class to interact with each other. We found that students tended to use GroupMe, text messaging, or Zoom for conversing with one another outside of class. In asynchronous courses, students spent on average 3.0 ± 4.9 hours per week interacting with each other compared to synchronous courses where they spent on average 1.2 ± 2.0 hours per week interacting with each other outside the online session. It is important to note that the median amount of time spent on student-student interaction was the same (1 hour per week) in the asynchronous courses as well as outside the online session for synchronous courses.

V. Discussion and Future Work

The results show that overall students preferred asynchronous courses to synchronous courses for the summer session. This could have been due to the flexibility offered by asynchronous courses compared to synchronous courses. While the students were moderately satisfied with the technologies/platforms and methods used, they showed a higher degree of satisfaction for courses that used more active methods and designed interactions rather than courses that just had a video. For instance, in synchronous courses, they showed a more positive reaction to the course when the faculty used polling, Q&A, and other methods for student engagement. A similar reaction was shown in their satisfaction with asynchronous courses.

While these data are very preliminary, they provide some design implications for asynchronous and synchronous courses. In asynchronous courses, the students appreciated the use of Zoom for live engagement. This indicates that future asynchronous course designs could benefit from including live interaction opportunities as part of the course. Similarly, for synchronous courses, adding opportunities for student engagement during live lectures by using chat sessions, polls, and similar tools would lead to higher student satisfaction. More analysis is needed to draw out transferrable conclusions.

Our early-stage results show that the first-generation students may be showing a lower satisfaction with the interaction in online courses and there may be accessibility issues faced by first-generation engineering students that need to be addressed when designing longer-range technology-enhanced courses. These issues need to be delved into further so we can derive technological and methodological recommendations to inform future designs. In the future, we plan to do focus groups to investigate more details about the students' experiences and preferences in online STEM courses, and also identify any issues with online courses faced by our first-generation students. In addition, a faculty focus group is planned to gain an understanding of experiences with the design and development of online courses that will affect their future adoption and adaptation.

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