

Comparing Techniques for Building Community and Promoting Inclusion in a Virtual Engineering Classroom

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Abstract—This is an innovative practice Full Paper. The COVID-19 pandemic forced virtually all education to operate remotely and faculty and students not typically accustomed to an online format had to quickly come up to speed in learning best-practices to teach and learn online. Engineering education research in the early days of the pandemic quickly revealed that building community and promoting inclusion in the classroom were key to promoting student success. However, in an emergency remote teaching environment where students are spread out and isolated from each other, building community can be more challenging. This paper studies student preferences (through student survey feedback) on community building and inclusion techniques by comparing three instructors' use of different techniques when teaching a common undergraduate engineering course.

Keywords—online, inclusivity, community building techniques

I. INTRODUCTION

The COVID-19 pandemic forced virtually all education into a state of “Emergency Remote Teaching.” Faculty and students not typically accustomed to an online format were forced to quickly come up to speed in learning best-practices to teach and learn online. With Emergency Remote Teaching, instructors and students had to face three major categories of challenges: technological (some students and instructors had unreliable internet connections and/or lack of necessary electronic devices), pedagogical (some teachers and learners possessed a lack of digital skills and a lack of structured content needed for teaching and learning online) and social (social distancing requirements and shelter in place orders made it next to impossible for in-person human to human interaction). [1] Engineering Education research in the early days of the pandemic quickly revealed that even if instructors and students could effectively handle the technological and pedagogical challenges associated with emergency remote teaching, tackling the social challenges through building community and promoting inclusion in the classroom were key to promoting student success (particularly among under-represented minority (URM) and female students) [2-8].

Centers for Teaching and Learning at many schools and universities started providing suggestions to Faculty on different techniques they could use to connect with students, connect students to each other, and assure students that the instructor was there to support their learning and success. [9-11] These

suggestions stemmed from community building practices that worked well in the non-emergency online classroom, which included actions to reach out to students early and often, limit lecture time and increase discussion, use multiple technical features/tools to encourage discussion, and share personal and professional information with students [2]. More specifically, suggestions ranged from conducting faculty and student introductions, icebreakers and weekly check-ins, to assigning group activities, to monitoring and participating in LMS (learning management system) discussion boards [12-14]. In addition, collaborative technological tools used in on-line and face-to-face classes pre-pandemic such as Slack[15-17], Piazza[18], FlipGrid[19-20], Padlet[21-22], and Jamboard[23-24] became community building options in the emergency remote teaching environment. Furthermore, Discord, a message board platform originally developed for gamers, became a popular method for students to communicate with one another outside of class in the absence of real-life opportunities for connection during remote learning [25-26].

Our current work builds on previous practice in that it looks at how three Professors selected different sets of the above-suggested techniques to promote community and inclusion in an online classroom. The three Professors taught different sections of the same lower-division computer design course during the Winter 2021 (during the COVID-19 pandemic) academic term. Note that the community building and inclusion techniques an individual Professor chooses to conduct are often a result of their comfort level with each of the activities and/or their comfort level with the technology needed to conduct the activity. This work differs from previous practice in that it specifically compares student perceived effectiveness of the used (and unused) community building techniques in an emergency remote teaching setting.

We organize the work as follows: we first describe the classroom setup for each of the three instructors and the community building / inclusion techniques they each chose to use (section II), then we describe the survey implement used to access the student perceived effectiveness of the techniques (section III). We then present the survey results coupled with a discussion of the results to give engineering and computing faculty (and faculty in general) ideas on which community building and inclusion techniques are most (or equally) effective in the emergency remote undergraduate classroom (section IV).

The work concludes with a summary of the study and its limitations (section V).

II. CLASSROOM SETUP & ACTIVITY SELECTION

We conducted this study within seven sections of an undergraduate computer design studio course (where studio means lecture and lab are combined into a single course setting) during the COVID-19 pandemic Winter 2021 academic term. Two sections were taught by Instructor A, three sections were taught by Instructor B, and two sections were taught by Instructor C. Each section had a unique cohort of 20-28 students. In the traditional face-to-face setting, each section of the course typically meets for six hours per week either in two three-hour blocks or three, twohour blocks for a total of ten weeks (e.g. 60 contact hours per section per academic term). Each week, in addition to lecture, students work with a lab partner to design a component of a RISC-V CPU in SystemVerilog (hardware assignment) and write increasingly more complex assembly programs (software assignment). The final project typically involves students writing a relatively complex assembly program to run on their fully integrated and functioning CPU.

When porting this class to an emergency remote teaching environment, all three instructors provided the same number of contact hours and generally used the same hardware and software assignments as they did in the face-to-face classes, but each instructor chose to set up the virtual classroom differently with different community building and inclusion techniques. The instructors independently chose their classroom setup and community building techniques based on their comfort level with each technique and their own guesses as to what would work best in the emergency remote environment. Table I shows the specific community building and inclusion techniques considered along with a brief description of each technique.

TABLE I. COMMUNITY BUILDING AND INCLUSION TECHNIQUES CONSIDERED

Technique	Description
Student Survey	A survey distributed to students at the start of the course to allow the instructor to get to know the students and their course expectations and concerns
Professor Intro	Professor shares his or her academic and personal background with the students
Flip Grid Intro	Professor and students introduce themselves to each other through Video using the platform Flip Grid
Requiring Cameras On	Professor requires that students keep their cameras on during class as part of the student course grade
LMS (Canvas) Discussion Board	An online platform built into an LMS where students and instructors can ask and answer questions in a forum-type format
Piazza	A free online platform where students and instructors can ask and answer questions in a forum-type format
Slack	A free online platform where students and instructors can ask and answer questions in a more organic way

Jamboard	A free online collaborative whiteboard/bulliten board
Padlet	A free online digital collaborative canvas to create projects that are easy to share
Discord (instructor run)	An online platform (monitored by the instructor) that allows members to communicate directly via voice, video or text about course content.
Discord (student /TA run)	An online platform (not monitored by the instructor) that allows members to communicate directly via voice, video or text about course content.
discord (non-class related)	An online platform that allows members to communicate directly via voice, video or text about non-course content (to promote socialization).
Daily ice breakers	Asking students to share their answers to a daily ice breaker question in small groups to get to know their peers
Weekly ice breakers	Asking students to share their answers to a weekly ice breaker question in small groups to get to know their peers
Breakout rooms during lecture	Putting small groups of students into separate virtual spaces (breakout rooms) to discuss lecture material and/or work on lecture related problems
Breakout rooms during lab	Putting small groups of students into separate virtual spaces (breakout rooms) to work on group lab assignments together
Diverse Computing Contributors	Professor highlights past or current contributors to the field being studied who are from diverse (and particularly under-represented) backgrounds
Giving Opportunities for feedback	Professor provides multiple opportunities for students to provide feedback about the course during the course (through surveys, discussion posts, office hours, etc.)

A. Instructor A

Instructor A taught two sections of the course and set up the course to run as close as possible to how she would run the course in person. As she was on leave for all of 2020, this was her first term teaching during the COVID-19 pandemic. She offered the course synchronously on Zoom during the designated class times and generally spent the first half of each Zoom session with live lecture (which was recorded for students to reference afterward) followed by putting students into breakout rooms to work on lab assignments. She assigned students a different lab partner each week to work on both hardware and software assignments so that students would have the opportunity to meet and work with a variety of people throughout the term. In addition, prior research had shown that instructor assigned, rotating lab groups work best for lower-division undergraduate engineering (in-person) lab courses [27]. She did not require students to have their cameras on, as she was unsure if all students would have consistent access to a web-camera and/or a stable internet connection that would support streaming video.

At the start of the course, she gave an introduction about her personal and academic background and sent the students a survey to get to know a little bit about each of them (their interests, their hopes and fears for the course, etc.) During the course, she provided multiple opportunities for student feedback (through informal polls and surveys) and presented a different contributor to computing each week from a different under-represented background to illustrate to students how the field of computing needs people of all backgrounds. [28] She did not use any specific technology (FlipGrid, Piazza, Slack, LMS Discussion Board, Jamboard, Padlet, or Discord servers) because she was unfamiliar with the technology or had used them in her in person classes in the past with little participation from students (Piazza and LMS Discussion board). She did not see a need for formal weekly or daily icebreakers as she encouraged students to talk to each other in their lab breakout rooms at the start of each week to get to know each other prior to working together on the weekly hardware and software lab assignments. She held five synchronous office hours per week on Zoom and asynchronously answered student questions via email or phone text.

B. Instructor B

Instructor B taught 3 sections of the course and made minor adaptations compared to how he would administer the course in person. While the instructor had previously taught project-based courses virtually due to the COVID-19 pandemic, this was the first time he was teaching this course remotely. Lectures were delivered synchronously on Zoom during the designated class times and recorded for students to watch afterwards. Lectures were typically limited to the first half of the class time. The remaining time was made open for students to utilize however they wanted. Optional breakout rooms were created for students to use, and the instructor and a lab assistant were available to answer questions or provide help individually. The instructor used a drawing tablet to replace the classroom whiteboard, but otherwise the lecture content and delivery did not differ from in person lectures. The instructor did not require students to have their cameras on during lecture. Hardware assignments were completed individually while software assignments were completed in instructor assigned pairs that changed each week. Students had a choice to complete a final project individually or in self-selected groups.

Before the start of the term, the instructor sent an email introducing himself, the course, and why the instructor enjoyed teaching this specific course. This introduction was repeated during the first class. Each class started with a time for students to ask questions without being recorded. The instructor created a common course Slack for all 3 sections and used it as the primary method of communication. Multiple channels were created for announcements, class discussions, and questions on the assignments. A specific Slack channel (#chill-zone) was created for interaction and non-class related discussions. The instructor posted memes and gifs at least weekly to encourage engagement. Slack was used extensively to provide help to students outside of class, often late at night and during weekends. Students were able to post questions in public channels where other students, lab assistants, or the instructor could answer. Students could also directly message the lab assistants or the instructor with questions. Slack analytics

showed that most weeks averaged 70 students being active (out of 77 students total) with 60 students posting and a total of 17095 messages being sent.

C. Instructor C

Instructor C taught two sections of the course, with the term of this study being his third term teaching two sections of the course during the COVID-19 pandemic. Because Instructor C assumed he would be teaching the course for multiple terms during the pandemic, at the start of the pandemic, he invested a large amount of time to learn how to create and create pre-recorded lecture videos for the course. He then opted to teach his sections in a flipped classroom style, asking students to watch the pre-recorded lectures for homework and using the entire synchronous Zoom session for students to ask questions and receive help with their lab assignments. He encouraged students to form student-selected groups to complete hardware and software lab assignments, although permitted students to complete lab assignments individually. Instructor C always left his camera on and allowed students their choice of cameras on or off.

As part of an initial lecture, he provided students with a personal, professional, and academic background, and put particular emphasis on the instructor's personal academic practices that would lead to a poor performance in the course. He also submitted a survey to students in the form of a quiz; the only question students were required to answer was their name. Other questions included which instructor they had for the pre-requisite course, questions about what allowed them to learn best, and an open-ended question soliciting any final student remarks. The instructor encouraged the use of the discussion board associated with the LMS (Canvas), but later switched to a Discord server because of low participation. The instructor encouraged students to work together in any way they could, but always emphasized taking their own assessments (quizzes and exams). The instructor made himself available for personal Zoom sessions during off-course hours including late night and weekends.

D. Classroom Set-Up Summary

Table II summarizes the community building and inclusion techniques used by each instructor and Table III summarizes the group assignment methods used by each instructor. Overall, we summarize Instructor A's community building techniques to focus on the use of break-out rooms, Instructor B's community building techniques to focus on the use of Slack, and Instructor C's community building techniques to focus on the flipped classroom nature of his course.

TABLE II. COMMUNITY BUILDING & INCLUSION TECHNIQUES USED

Technique	Instructor A	Instructor B	Instructor C
Student Survey	X		X
Professor Introduction	X	X	X
Slack		X	
LMS Discussion Board			X

Technique	Instructor A	Instructor B	Instructor C
Discord (instructor run)			X
discord (non-class related)		X	
Breakout rooms for lab	X (required)	X (optional)	
Sharing Computing Contributors	X		
Providing opportunities for feedback	X	X	X

TABLE III. GROUP ASSIGNMENT METHODS

Group Assignment Method	Instructor A	Instructor B	Instructor C
Individual or Group	Group for all assignments	Individual for hardware, group for software assignments	Individual or Group for all assignments
Fixed or Rotating	Rotating	Rotating	Fixed
Instructor Assigned or Student Selected	Instructor Assigned	Instructor Assigned	Student Selected

III. SURVEY IMPLEMENT

In order to access the effectiveness of each community building and inclusion technique, we designed an Institution Review Board (IRB) approved anonymous survey for students to complete. Each instructor posted a link to this survey on the course's LMS (and Slack or Discord server if used) and gave students multiple reminders asking them to voluntarily complete the survey.

We divided the survey into four sections. The first section asked students for general background information related to taking this course virtually. These questions were (with response options given in parenthesis):

1. Who was your instructor for CPE233 in Winter 2021? (Instructor A, Instructor B, Instructor C)
2. Prior to starting CPE233, did you have friends in your section or other CPE233 sections? (Yes, No)
3. Was this your first time taking CPE233? (Yes, No)
4. How would you rate the reliability of the internet connection where you resided for the duration of the course? (No internet connection, intermittent/unreliable, semi-reliable, mostly-reliably, always, reliable)
5. How would you rate the internet speed where you resided for the duration of the course? (None, Dial-up, Slow broadband, high speed broadband, very high speed (fiber optic))

6. Did you have easy access to a webcam on your primary device used for course activities? (Yes, Sometimes, No)
7. Did you have to monitor or restrict internet usage due to data caps from your service provider? (Yes, No)
8. Where did you reside for most of CPE233? (On campus, Off-campus in San Luis Obispo by myself, Off-campus with other students, At my parent's/relatives home in the Pacific time zone, at my parent's/relative's home not in the Pacific time zone, At my own home in the Pacific time zone, At my own home not in the Pacific time zone, Other)

The second section asked for demographic information. In order to keep the survey anonymous, we did not ask students to identify their specific gender, race, or ethnic background as this information could single out a specific student. Instead, we asked the following:

1. Are (were) you a transfer student?
2. Are you a first generation student (first in your family to attend college)?
3. How many years have you been at Cal Poly including this year?
4. Do you consider your racial or ethnic group to be under-represented in the field of computing?
5. Do you consider your gender to be under-represented in the field of computing?

The third section asked students to provide an overall reflection of the course by answering each of the following statements with their Likert scale level of agreement (5-Strongly Agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly Disagree):

1. I think building community and promoting inclusion in a classroom is important for my learning.
2. I felt a sense of community in my CPE233 course.
3. I got to know other students in my CPE233 course.
4. I felt I had sufficient access to my Professor in my CPE233 course
5. I felt isolated in my CPE233 course.
6. I wish my Professor had made more of an effort to build community and promote engagement in CPE233.
7. I wish my Professor would have delivered lecture content differently
8. I wish my Professor would have set up lab groups differently
9. I found it hard to be engaged in my CPE233 course.
10. I felt my Professor cared about my learning

Finally, the last section asked students to rate the effectiveness of each of the community building / inclusion techniques (Table I) used in their computer design course on a scale of 1 (not effective or useful) to 4 (very effective or useful).

For the activities not used in the course, we asked the students to select if they would have preferred it being used (assigned a value of 4) or if they preferred it not being used (assigned a value of 1). This section then ended with asking students the following questions about group assignment methods:

1. In general, which do you prefer in the virtual environment? (Working on lab assignments individually, Working on lab assignments in a group, no preference)
2. In general, if you had to do group work, which do you prefer in the virtual environment? (Rotating Groups, Fixed Groups, No preference)
3. In general, if you had to do group work, which do you prefer in the virtual environment? (Instructor Assigned Groups, Student Selected Groups, No Preference)

The survey concluded with the following open ended question: "Is there anything you would have liked to see your Professor do (or use) in your virtual classroom to better promote community, inclusion and engagement."

IV. SURVEY RESULTS & DISCUSSION

Of the 178 students surveyed (across seven sections), 79 students responded to the survey (44% response rate) and all of them lived in the same time zone as the course. Of the 79 respondents, 14% considered their racial or ethnic group to be under-represented, 15% considered their gender to be under-represented, 24% were first generation students, and 30% were transfer students. Furthermore, 20% had inconsistent (or no) webcam access, 12% had semi-reliable or un-reliable internet access, 50% were living without other students and 28% did not know any students in the class prior to the class. Table V below shows the breakdown of respondents in these different groups across the three instructors.

TABLE IV. SURVEY RESPONDANT DEMOGRAPHICS

	Instructor A	Instructor B	Instructor C
Total in sections	53	77	48
Number Respondents	23	38	18
Under-represented gender	6	3	3
Under-represented race	4	6	1
First Generation Students	8	7	4
Transfer Students	7	12	4
Inconsistent or No Webcam access	6	8	2
Semi-reliable or unreliable internet connection	3	5	1
Living without other students	10	22	8
Did not know students prior to class	4	11	7

A. Survey Results by Instructor

Table V shows the average Likert scale responses to the overall reflection questions from the third section of the survey broken down by Instructor. To get a better sense of distribution of responses, the table also shows the percentage of students who indicated a level of agreement (response 4 or 5) followed by the percentage of students who indicated neutral (response of 3) in parentheses.

From the table, we see that most students across all instructors felt they had sufficient access to their instructor and their instructor cared about their learning. Next, we see that most students agreed that building community is important and felt the instructor did not need to make more of an effort to build community. We see that the techniques used in Instructor A's class set-up likely allowed students to get to know other students better over the techniques used in Instructor B's set-up or the techniques used in Instructor C's set-up. However, students in Instructor A and B's sections felt about the same level of agreement in feeling a sense of community and about the same level of disagreement in feeling a sense of isolation. Instructor C's set-up might have led to a slightly decreased sense of community and increased sense of isolation.

Furthermore, it is interesting to note that even though students overall had some agreement to feeling a sense of community and getting to know other students, the majority of students in all sections felt disengaged in the course. It is also interesting that even though Instructor A's class had a higher agreement in getting to know other students and feeling engaged, it also had higher agreement in wishing lab groups were set-up differently. Three open-ended comments did note that students in Instructor A's course would have preferred rotating lab partners less frequently (perhaps on a bi-weekly rather than weekly basis). While the instructors delivered lectures differently (synchronously and asynchronously), no set of students indicated a strong desire for changing lecture delivery, although a slight preference for synchronous delivery may be indicative from the relatively fewer percentage of Instructor A and B student's indicating the synchronous delivery should be different compared to Instructor's C asynchronous lectures.

TABLE V. OVERALL REFLECTIONS
LIKERT SCALE AVERAGE (PERCENT AGREEMENT, PERCENT NEUTRAL)

Statement	Instructor A	Instructor B	Instructor C
Instructor cared about student learning	4.83(96, 4)	4.86 (95, 5)	4.56 (89, 0)
Sufficient access to instructor	4.65 (96, 4)	4.78 (95, 5)	4.56 (89, 5)
Building community is important	4.22(78, 22)	3.95 (74, 18)	4.06 (78, 17)
Instructor should make more of an effort to build community	2.00 (13, 44)	1.95 (5, 29)	2.11 (17, 6)
Got to know other students	4.13 (87, 10)	3.41 (50, 21)	3.00 (39, 17)
Felt sense of community	3.74 (57, 38)	3.76 (61, 24)	3.33 (50, 28)
Felt isolated	1.91 (9, 41)	1.86 (13, 7)	2.28 (17, 11)
Student felt engaged in course	2.35 (17, 40)	1.81 (8, 8)	1.94 (17, 11)
Delivered Lecture differently	2.35 (13, 52)	1.70 (5, 7)	2.56 (22, 28)
Set up lab groups differently	2.26 (13, 45)	2.22 (11, 21)	1.94 (17, 17)

Table VI shows the average Likert scale-like responses to the individual community building and inclusion techniques where a score of 1 suggests not effective and a score of 4 suggests very effective. The table also shows the percentage of respondents who indicated a response of 3 or 4 (effective). If the instructor did not use a specific technique, the data shown present how much the students wished the technique had been

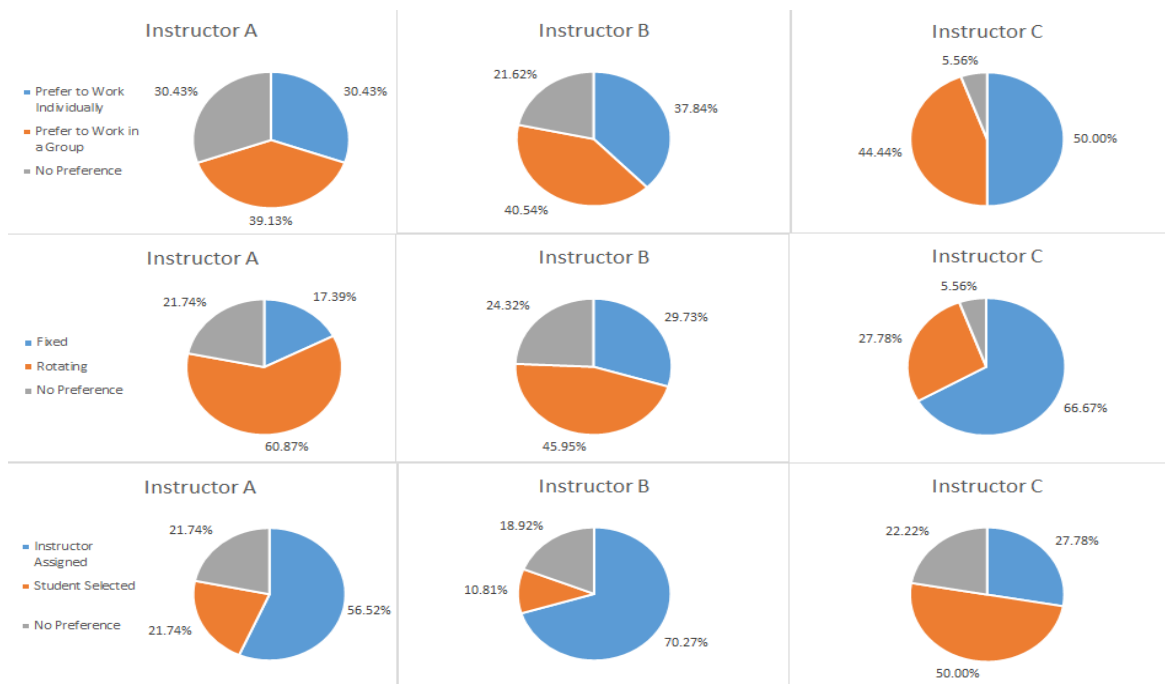


Fig 1. Group Assignment Method Preferences

used. Thus, any average score over 2.5 suggests the technique was mostly effective (or wished to be used) and any average score under 2.5 suggests the technique was mostly not effective (or not wished to be used). Numbers that are bolded are for the **techniques used** by the instructor. Numbers in red are for techniques not used by the instructors that the majority of that instructor's students **wished had been used**.

TABLE VI. PERCEIVED EFFECTIVENESS OF INDIVIDUAL TECHNIQUES
LIKERT SCALE AVERAGE (PERCENT EFFECTIVE (RESPONSE OF 3 O 4))

Technique	Instructor A	Instructor B	Instructor C
Student Survey	3.29 (81)	2.86 (62)	3.24 (82)
Professor Intro	3.68 (100)	3.76 (95)	3.82 (94)
Flip Grid Intro	1.27(9)	1.35 (11)	1.88 (29)
Cameras On	1.65 (21)	2.02 (34)	2.06 (35)
Canvas Discussion Board	1.95 (32)	1.25 (8)	2.58 (53)
Piazza	1.80 (27)	1.40 (14)	2.12 (38)
Slack	1.81 (27)	3.97 (97)	1.56 (18)
Jamboard	1.00 (0)	1.18 (5)	1.19 (6)
Padlet	1.00 (0)	1.18 (5)	1.19 (6)
Discord (instructor run)	2.68 (54)	2.58 (51)	3.53 (88)
Discord (student / TA run)	2.71 (54)	2.58 (51)	2.88 (59)
discord (non-class related)	2.36 (45)	2.83 (61)	2.40 (47)
Daily ice breakers	1.68 (22)	1.56 (18)	1.70 (24)
Weekly ice breakers	2.36 (45)	2.08 (35)	2.58 (53)

Technique	Instructor A	Instructor B	Instructor C
Breakout rooms during lecture	2.22 (41)	1.75 (24)	2.06 (35)
Breakout rooms during lab	3.14 (82)	2.62 (53)	2.05 (35)
Computing Contributors	3.09 (73)	2.71 (56)	2.94(65)
Opportunities for feedback	3.45 (83)	3.39 (81)	3.53 (88)

The data in Table VI show us that if the instructor used a community building / inclusion technique (shown in bold), the majority of students found it effective, with most average scores being over 3.0 (and percent agreement being over 80%). The techniques that instructors used that did not receive as high ratings were breakout rooms for lab and discord (non-class related) for Instructor B and LMS Discussion board for Instructor C. However, breakout rooms for Instructor B saw a skew due to different assumptions about the question as breakout rooms were optional (14 students selected they were happy they weren't used while 6 indicated they wished they had been. The remaining 17 gave an average score of 3.35 indicating they found the use of breakout rooms effective). Also, Instructor B's students may have made different assumptions about the "discord (non-class related)" technique as Instructor B used a specific Slack channel for non-class related discussion (#chill-zone), rather than using *Discord* for this purpose. As students in Instructor B's class found Slack extremely effective, it is likely they appreciated the #chill-zone channel. Finally, as for the use of the LMS Discussion board, it appears that when given the option, students greatly preferred the use of a Discord server for classroom communications instead of the LMS Discussion

board (Instructor C). Recall that Instructor C switched to Discord because LMS Discussion participation was low.

The techniques that students did not use, but somewhat wished had been used (shown in red in Table VI) included student surveys, class-related Discord servers, (either instructor or student/TA), and sharing weekly computing contributors from diverse backgrounds. These techniques were all used by at least one other instructor, so it is possible that some students were told by their peers in other sections that these techniques were effective. Conversely, it is likely that students did not suggest using specific technologies like FlipGrid, Piazza, Jamboard, or Padlet because, like the Professors, they were unfamiliar with the technology and were not able to visualize how it could be used as an effective inclusive community-building tool. In hindsight, it would have been useful to ask individual students if they had used these specific tools in any of their other virtual classes.

Finally, although the data suggest students do not find breakout rooms for lecture, daily ice breakers, or being forced to keep their cameras on effective for building community, their response may more likely represent that they do not like being required to do these things (i.e. they like being able to keep their camera off and listen passively to lectures) even if these techniques could foster a stronger sense of community and engagement.

The data for results on group assignment methods follow the same trend. Students generally preferred the group assignment method used in their specific course (Fig 1) even though the questions asked *in general*, which do you prefer in a virtual environment (individual or group, fixed or rotating, instructor assigned, or student selected). Recall Instructor A used rotating instructor assigned groups, Instructor B used a mix of both individual assignments and rotating instructor assigned groups and Instructor C used student-selected fixed groups (which could be a size of 1). It is also reasonable to surmise that the group assignment method selected may have been the best fit for the given class set-up.

The open-ended response question revealed that two students would have preferred live lectures (in Instructor C's case), three students would have liked to have less frequent rotating lab partners (in Instructor A's case), two students would have preferred to have some kind of discussion board / discord tool (in Instructor A's case) and five students thought Slack was great (in Instructor B's case). Two students also specifically made comments about having cameras on:

"While I do appreciate that cameras were not required to be on, I think I would have appreciated there being an expectation of camera on because it would have made engagement and participation better."

"I think that when class is asynchronous the cameras should be on to prevent distractions (this is for me personally), and so that the class can better build a community instead of vacuous names with no face to attach to them."

B. Survey Results by Demographic Group

To see if there were any community building techniques and overall sentiments that were more effective (or felt more

strongly) for some demographic groups (minority) over other demographic groups (majority), we broke the data into the following categories:

- minority gender vs. majority gender
- minority races vs. majority races
- first generation student vs. not first generation student
- transfer student vs. first time freshman student
- students who live without other students, vs. students who live with other students
- students who had friends in the class prior to the class vs. students who did not have friends in the class prior to the class
- students with semi-reliable (or worse) internet connection vs. students with mostly-reliable (or better) internet connection
- students who did not have consistent web cam access vs. students who had consistent web cam access

Because the sample sizes of the minority demographic groups are small (see Table IV), it is difficult to generalize about their preferences. To glean some information from the data, we ran t-tests (using Excel's T.TEST function with a one-tailed distribution of heteroscedastic data) to look for statistically significant differences. Table VII below shows the community building techniques or overall sentiments that had p-values of less than 0.05 (considered statistically significant) for the different demographic groups.

TABLE VII. STATISTICALLY SIGNIFICANT TECHNIQUES/SENTIMENTS BETWEEN DEMOGRAPHIC GROUPS

Group	Technique/Sentiment
Under-represented gender	Stronger feeling that Building Community is Important
Under-represented race	none
First Generation Students	none
Transfer Students	none
Students who live with other students	none
Students who knew students in the course prior to the course	Stronger Feeling that Building Community is Important Stronger feeling of Sense of Community Stronger feeling of getting to know other students
Students with Inconsistent web-cam access	Less desire for breakout rooms for lecture and lab Less desire to have cameras on
Students with semi-reliable or worse internet connection	Less Sufficient Opportunities for Feedback

The first result shown in Table VII is consistent with the literature – students who feel their gender is under-represented in the field of computing (namely female students) more strongly believe that building community is important for their learning. However, our results indicate they do not have statistically significant stronger preferences on one community building technique over another in comparison to students in the

majority gender. The next four entries in the table are correlated as our transfer student respondents had a higher percentage of first generation students, under-represented minority students, and students who live without other students than our first time freshman respondents. Our data showed no significant differences in preferences of community building techniques between these minority demographic groups and their majority demographic group counterparts.

One very interesting (albeit possibly obvious) result is that students who knew students in the course prior to the course felt more strongly that building community is important, felt a stronger sense of community, and felt they were able to get to know students better than those students who did not know anyone in the course prior to the course. This result suggests that knowing students may help you get to know more students and build community. It also suggests that people who value building community likely make more of an effort to do so.

Finally, the last two rows of Table VII make sense technologically speaking as if you do not have consistent access to a web-camera, you likely would prefer to be required to have a web-camera on, or be put in break-out rooms where the use of web-cameras is more extensive. Also, as having a reliable internet connection is the primary means for course communication (be it via email, Slack channel, or office hours), those with semi-reliable or worse internet connection felt that had less sufficient opportunities to provide feedback than those with better internet connections.

V. STUDY SUMMARY AND LIMITATIONS

From the data, it is clear that students are generally satisfied with whatever community building techniques and group assignment methods the instructor uses seemingly so long as they see the instructor cares about their learning, makes an effort to be available for students, offers opportunities for feedback, and makes some effort to build community. A majority of students find Discord servers useful and appreciate learning about contributors (from diverse backgrounds) to the field they are studying. Students in Instructor B's sections clearly found Slack a useful tool, but those that didn't use it (Instructor A and Instructor C's sections) didn't seem to miss it. This could be due to never using Slack in a class before or other courses using Slack less effectively. It is unclear if students find other specific tools like FlipGrid, Jamboard, Padlet, and Piazza ineffective, or if they just feel they are ineffective because they have never seen them used (or used effectively).

Furthermore, when looking at preferences and overall sentiments based on demographic groups, the key demographic difference for feeling a sense of community was whether the students had friends in the class prior to taking the course. Although not necessarily a surprising result, the take-away implies that whatever techniques help students to get to know more students in the current class will help students build and feel community in subsequent classes.

A surprising take away from this study was the fact that even if students did get to know other students and feel a sense of community, they still did not feel engaged in the course. This outcome suggests that the community building and inclusion techniques do not necessarily overlap with engagement

techniques, but also suggests that engagement in an emergency remote teaching environment is hard to obtain. The open-ended responses suggest that forcing students to keep their cameras on could possibly increase engagement (albeit begrudgingly).

It is important to note that although this study offers some important insights into student perceived effectiveness on community building techniques, this study does have its limitations (including, but not limited to):

- 1) the study only captures the opinions of the 44% of the students in the courses (the survey had a 44% response rate),
- 2) the study's sample sizes (especially of some of the specific demographic populations) are small,
- 3) the study does not examine the effects of the same instructor using different sets of techniques (some instructors may be better at using a given technique effectively), and
- 4) the study results may include confirmation bias (e.g. students may have indicated they felt the techniques the instructor used were effective because they previously found these techniques effective in other courses.).

Still, we feel the study does show that because no technology or technique stood out as being highly preferable to students (even for specific demographic groups), the best approach would be for instructors to use whatever method they can use the most effectively to promote student success in the courses they teach. Instructors should support inclusive teaching practices that prioritize techniques allowing for ample student-to-student and student-to-instructor interaction. The students will generally respond well to whatever techniques the instructor uses if they see the instructor is making their best effort to deliver a positive classroom experience.

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