



# Investigating Two-Stage Exams in a Remote-Teaching Environment



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## Introduction

After the outbreak of COVID-19, and with classes moving to a temporary online environment, we were interested in exploring the operation of such exams in an exclusively online world. We believe it is imperative to include students as partners in course design, especially during the pandemic when we are required to pivot to remote instruction with little lead time. To include the student voice in our planning, we used an action-research methodological approach to explore the student experience of two organic chemistry midterm exams. We used online surveys to probe the student experience before and after each exam and elicited suggestions for improvements over the term.

## CHEM 233: Organic Chemistry for the Biological Sciences

- CHEM 233 is designed for students not intending on pursuing a degree in chemistry or biochemistry
- Approximately 1500 students take CHEM 233 per academic year
- Summer Term 1 2020 enrollment was 427 students, distributed over 1, remotely taught course section
- Lectures occurred MWF from 12:30-3:00 pm PDT
- Content delivered using Collaborate Ultra as a synchronous pen cast onto templated PowerPoint slides
- Students were expected to complete the slides as content is covered, and solve questions embedded within the slide decks
- All lectures were recorded, and all completed slide decks were posted onto Canvas immediately following the class
- Students could obtain asynchronous help using the course Piazza page, as well as teaching assistant office hours (about 6 hours per week)

Table 1: Grading Scheme in CHEM 233 Summer 2020

Item	Percent of Course Grade
Midterm 1	14%
Midterm 2	16%
Final Exam	35%
Sapling Online Homework	9%
Weekly Quizzes	24%
In Class Participation	2%

## Exam Design & Invigilation

- Both midterm exams were designed to be two-stage exams invigilated using Zoom
- Exams were run with 'open-resources'. Students were allowed access to textbooks, course notes, course problem sets and practice exams and internet resources. Students were not allowed to communicate with anyone during the individual portion of the exams
- Exams consisted of multiple choice and short answer type questions
- Multiple choice was run using the "updated" Canvas quiz feature
- Short answer was run using GradeScope software.
- Both multiple choice and short answer pdf exam parts were time released at the same time.
- Teaching assistants (TA's) were employed to invigilate during the individual portion of the midterm examinations

## Information from Student Surveys

- From the start-of-term survey, we learned that students were overwhelmingly supportive of having two-stage exams in CHEM 233.
- Only 3% of respondents (N = 403) had never participated in a group exam
- Most students reported that they thought online courses should have opportunities for peer learning
- After midterm 1, we obtained feedback that most aspects of the online group exam experience felt similar to in-person group exams (**Fig. 1**)
- We received feedback in two key areas:
  - Students did not feel they had adequate time to discuss exam content during the group portion of the midterm
  - Students expressed a desire to form their own groups for midterm 2

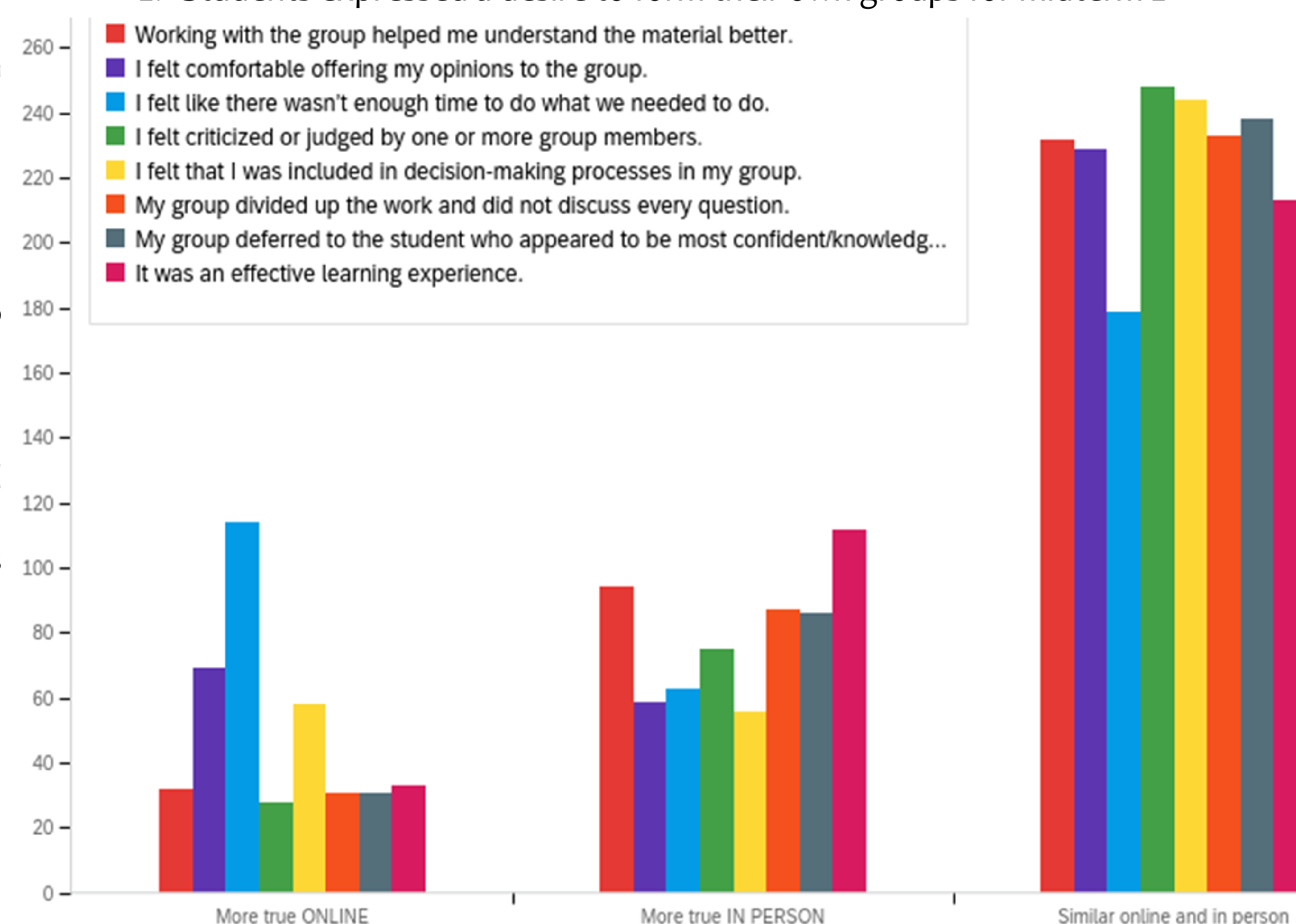


Figure 1: Qualtrics survey data comparing online group exams with in-person group exams (y-axis is number of survey respondents)

## Exam Design using information from student surveys

### Time for Group portion

- Midterm 1 was designed to have 45 minutes for the group portion of the exam
- Midterm 2 was designed to afford students 60 minutes in the group portion of the exam
- The time between Stage 1 and Stage 2 (**Fig. 2**) was increased from 5 minutes to 10 minutes for the second midterm exam

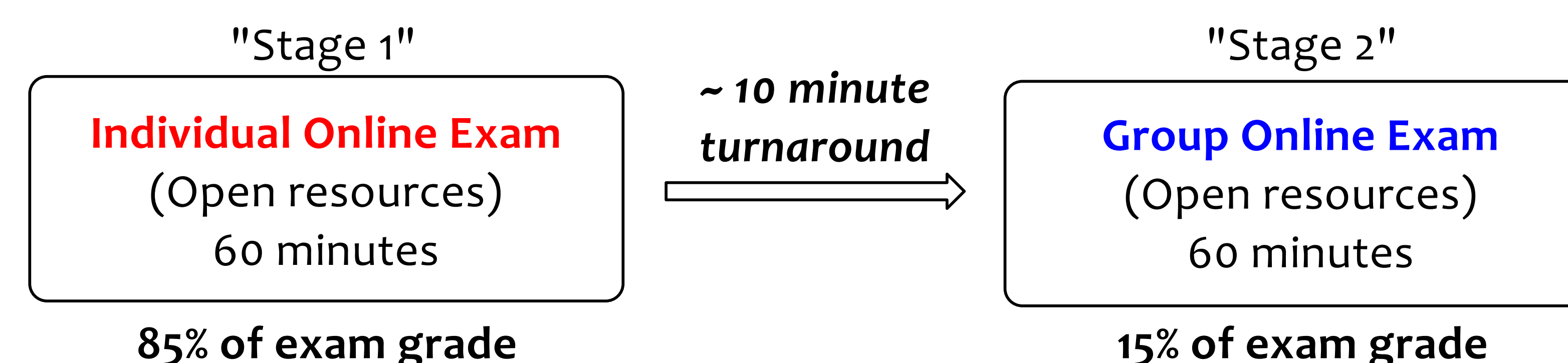


Figure 2: Design of midterm 2 incorporating student feedback

## Pre-Forming Groups

- For midterm 2, we attempted to allow students to pre-form their own groups
- 4 Zoom meetings were required for this to happen (**Table 2**)

Table 2: Room Design for Midterm 2

Room	Start Time (PDT)	Information
Room 1	6:00 pm	Students with surname (A – L)
Room 2	6:00 pm	Students with surname (M – Z)
Room 3	7:10 pm	Students that pre-formed groups
Room 4	7:10 pm	Students that did not pre-form groups

- Students were instructed that they would need to leave the meeting/room they wrote the individual exam and enter the appropriate group exam room
- Students that wished to pre-form groups were instructed that one member would need to email information of all members
- To pre-form groups, students needed to use the email address that was used to register with Zoom. This was announced to the class several times prior to the second midterm exam
- Students were also told that we were going to try to see if we could pre-form groups, but to be aware that it may not work
- These emails are entered onto an Excel sheet that is saved as a CSV file
- IDEALLY, once everyone arrived to the room, the software would sort them automatically

## THIS DID NOT WORK WELL, AT ALL

- Once sorted, a **SIGNIFICANT** number of students remained in the "main room" (approximately 125 out of 200)
- Students then panicked, turned on their microphones and all began telling the faculty member in charge (Jay) the names of the people in their groups
- Some students were properly placed into their breakout rooms
- As a result, students remaining in the "main room" were **MANUALLY** sorted into groups
- This practically took around 5 – 7 minutes of time

### So what went wrong?

- While we are not sure, we suspect that some students did not provide the email that they used to sign-up for Zoom, instead providing any email that came to mind when requested by their team member
- This could possibly explain why some groups sorted correctly, and others did not
- Further work is required to optimize this process. The authors strongly caution attempting this in a large class setting

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# Appendix



## Exam Set-Up Considerations

- For our exams, invigilators were both TA's and faculty members with a licensed version of Zoom which allowed for up to 300 participants per meeting
- One faculty member would host the room, and approximately 6-8 TA's depending on expected room capacity
- TA's should be instructed to put "TA – First name, Last name" as their Zoom handle. This allows the faculty member to quickly identify them from other students
- Invigilators should disable person-to-person private chat features in Zoom prior to releasing the meeting to the students
- Invigilators should disable the waiting room feature with large classes
- A "back-channel" was set up using WhatsApp for all TA's and faculty members to communicate real-time during the exam. Very useful!
- Multiple choice for the group exam should not have randomized questions to allow students to see each question at the same time.
- First question in the group multiple choice should be open answer and have students enter their student IDs. The top of the group short answer portion also has an area for ID's to be entered
- The student in the group that opted to be the scribe needed to be able to share their screen with all members of the group
- Only one person submits group exam multiple choice and short answer
- Students are told that if all members submit the group exam, and if the scores differ, the lowest score will be counted. This is to prevent students from guessing answers on the exam. This was only enforced 4-5 times over both midterm exams
- Provide students with a reason to try out Zoom and GradeScope before the date of the midterm to minimize panic about using these programs

## Generalized Chronology of a CHEM 233 Midterm Exam

1. Students distributed into two rooms alphabetically. Zoom links posted on Canvas prior to exam
2. Students arrive to their assigned rooms up to 30 minutes in advance of the start of the exam
3. Students are sorted into breakout rooms about 5 minutes before the start of the midterm exam
4. TA's sorted to ensure approximately 1 TA per 25 students (around 8 breakout rooms in Zoom)
5. Any students that arrive late are left in the "main room" with the faculty member
6. Students complete individual stage of midterm exam and submit multiple choice and short answer portions within the noted timeframe
7. Once completed, students should remain in the Zoom environment if they wish to write the group exam
8. When time has expired, students are pulled from their breakout rooms into the main room. At this point, an announcement is made that if any student does not wish to write the group exam, they may leave now. Teaching assistants are also excused.
9. Students are then sorted into new breakout rooms with about 4-5 students per room
10. Students complete the group stage of the midterm exam. This portion of the exam was not invigilated with TA's

## The Centre for Accessibility (CFA)

- Student should be informed of the cut-off date to register for a midterm examination. This is more important administratively online than in traditional exam settings
- The CFA instructs students that have missed the cut-off date to email the professor to see if anything can be done
- It is not easy to accommodate these students in an online exam setting with a limited number of Zoom licenses and available faculty members available
- The CFA is told when the group portion of the exam is to start. This usually requires that students with the CFA begin writing the exam early, so as to finish at the same time as the other rooms
- Students writing with the CFA are told that if they wish to write the group portion of the exam, and once their work from the individual exam has been submitted, to join the appropriate room using the links provided to all students on Canvas
- In this situation, students arrive into the main room. Once all students are recalled from their breakout rooms, the CFA students are sorted along with everyone else

## Exam Administration Considerations

- The faculty member would remain in the "main room" during the exam, while TA's are sorted into breakout rooms with students
- Student identification was not practically checked during midterm exams, but students were told that they should have ID with them
- Students were told not to ask questions to the invigilators. If any typo existed it would be addressed only after the exam had finished. Students should "answer the question the best that they can"
- Students were told to keep their microphone off unless the invigilator requested it be turned on during the exam
- If students lost connection during the exam, they were told to reconnect to Zoom as soon as possible, but to continue writing the exam. TA's would note students that disappeared, and when students returned they would remain in the main room (not sorted into a breakout room again)
- If Zoom would not work for a particular student, the Collaborate Ultra platform was used, or in one case FaceTime was used.
- Anecdotally, students are quite concerned about losing connection during the exam. Try to reassure them that it is okay if it happens, and they should try to reconnect as soon as possible.
- Instruct students to minimize bandwidth consumption during the exam