

Zoom Experiences in Higher Education: helping college students build data visualization capacity remotely

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Abstract—This Innovative Practice paper presents the redesign of an introductory data visualization college course to foster participation and engagement in an online setting. Four classroom exercises, referred to as “Zoom Experiences,” are described. *Zoom Experiences* varied depending on the topic being covered and were different each day to keep students’ interest. Students were asked to indicate if they would recommend the “experience” (or not) using a 5-point Likert Scale ranging from: (1) I would definitely NOT recommend, to (5) I would definitely recommend the exercise. A total of 84 responses were analyzed. Analysis of responses indicate over 57% would recommend or highly recommend the activities, 35% would likely recommend, and 8% would not recommend the activities. The goal of the experiences was to help students stay engaged in an on-line element of a course originally designed for in-class participation.

Keywords— *e-learning, data visualization, critical thinking*

I. INTRODUCTION

This paper examines the redesign of an introductory data visualization college course to foster class participation and engagement in an online setting. In fall 2020, in-person engagement was reshaped to mitigate challenges encountered while providing socially distant, compliant delivery of classroom content. Small steps and major moves were made to keep and maintain class participation and engagement while building data visualization capacity of students are discussed. Students’ perception of the efforts to foster class participation and engagement are also presented.

The introductory course consists of two sections, meeting twice a week. The 16-week, 3-credit course met twice a week for 1 hour and 40 minutes each meeting, in a lecture/lab format. Students enrolled in the course were sophomores or higher. Students who enroll in the course self-report as having little to no experience visualizing data. In fact, students are limited in their view of what data is. Most students are familiar with or at least knowledgeable of basic features in Microsoft Excel for generating graphs. Some students are familiar with MATLAB. As novices to data visualization, students have no knowledge of the multistage process of visualizing data.

The course was originally designed for a collaborative problem-solving environment which fostered organic

conversations and interactions between students as part of hands-on activities in the class. A variety of delivery methods were explored to help students connect the dots between the material and underlying course content presented in a non-traditional but engaging way. Four descriptions of exercises, referred to as “Zoom Experiences,” are described. *Zoom Experiences* depended on the topic being covered and were varied each day to keep students’ interest.

Regardless of delivery method, all learning requires engagement [1]. Cognitive load theory and the cognitive theory of multimedia learning inform this work. Both theories are based on the idea that humans have limited cognitive capacity but that meaningful learning requires learners to engage inappropriate cognitive processing during learning [2]. Fig. 1 shows an engagement matrix referenced when developing activities to foster participation and engagement in the classroom for the practices detailed in this work.

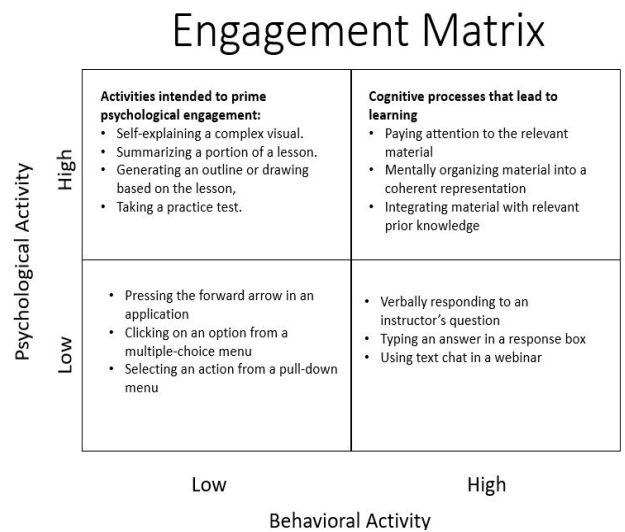


Fig. 1. Engagement Matrix (adopted from [2]).

Clark and Mayer [1] explain:

Learning occurs in the upper cells of the matrix in the zones of high psychological activity. Note that high levels of behavioral activity do not necessarily correspond with high levels of psychological activity (lower right quadrant). Conversely, high levels of behavioral activity don't necessarily translate into the type of psychological processing that supports learning. (pp. 16)

Likewise, meaningful learning can occur in the absence of behavioral responses. The goal is to use media elements and instructional methods that fall into the upper half of the matrix (pp. 17).

This paper discusses logistical challenges encountered, by faculty and students, small steps taken to address these challenges, and major, innovative, moves made to facilitate participation and engagement of students in an online environment.

II. LOGISTICAL CHALLENGES

The first logistical challenge presented in the conversion to the hybrid format model where students participated in virtual learning (lecture), and in in-person learning for laboratory instruction. A total of 31 students enrolled in the fall 2020 data visualization course. COVID guidelines implemented at X University followed seating guidelines to maximize safety of students and instructors according to CDC recommendations. Thirty-one students enrolled in the course. To remain compliant, seating for each lab session was limited to 24 students per lab plus an instructor. Students were assigned to two groups consisting of 15 (Group 1) and 16 (Group 2) students each. The course met twice a week for each section. Ordinarily, lectures are held on the first day and lab on the second day. Table I shows the lecture and lab schedules for each group in fall 2020. For each week, Day 1 consisted of an online lecture for Group 1 while Group 2 attended in-person lab. Day 2 consisted of the online lecture for Group 2 and the in-person lab for Group 1. This allowed for simultaneous delivery of online lectures by instructor and in-person delivery of lab content by a graduate teaching assistant.

TABLE I. LECTURE AND LAB SCHEDULE

<i>Group</i>	<i>Lecture (Online)</i>	<i>Lab (In person)</i>
Group 1 (<i>n</i> = 15)	Day 1 (Tuesday)	Day 2 (Thursday)
Group 2 (<i>n</i> = 16)	Day 2 (Thursday)	Day 1 (Tuesday)

Once assigned to a group, students were not allowed to switch labs. For example, if a student could not attend their assigned lab, for whatever reason, they could not physically attend the other lab as this would hinder the university's effort to know who is approved to be in the class/lab. As expected, for the first week, there were one or two students who attended the first lecture twice instead of going to the in-person lab they were assigned to. Each instance was handled individually to ensure

the student was able to catch up with lab work. After week two, however, students were expected to attend the lecture and lab they were assigned to.

The next logistical challenge related to virtual platform issues. At the time, there was no university-wide consensus on which platform to use. There were many to choose from: WebEx, Microsoft Teams, Zoom, Skype, Google Chat, the list went on. Having the freedom to choose the platform of choice led to a variety of platforms students had to learn and engage with sometimes several in a day. From a faculty's perspective, if the course was not developed for distance learning, choosing a platform that best met the needs of the course was an additional challenge. Also, there were unexpected, nation-wide technical challenges that included, but were not limited to platform specific issues as well as bandwidth issues.

Perhaps one of the biggest challenges was the university change in learning management systems from Black Board to Brightspace in fall 2020 semester. Although no one could have predicted the COVID-state of things, learning to navigate Brightspace in the midst of the redesign of course content and delivery was a patience-building experience for instructors and students alike.

Visualizing data is messy and complex. It is a multi-stage process that takes time and practice to appreciate [3]. For this course, the data visualization process is introduced in seven stages: acquire, parse, mine, filter, represent, refine, and interact [4]. There are various workflows for the data visualization process, but they all have the basic seven stages listed above. In previous work, [5] utilized, Fry's workflow for simplicity of introducing the data visualization process to novices. The workflow proved to be beneficial when explaining the iterative nature of the process and for providing a progressing learning path for visualization pedagogy.

III. FACILITATING A PRODUCTIVE COURSE ENVIRONMENT

Fall 2020 was a surreal experience for faculty and students. It was important for students to know of efforts being made to facilitate a productive and healthy semester. Three key steps were taken to help facilitate a productive and healthy course environment.

1. Each lecture began with an encouraging statement about student's perseverance and tenacity for opting for the in-person experience
2. Students were congratulated on following the COVID-safety plan instituted by the university.
3. Organization and time management aspects of the course were discussed regularly.

As the semester progressed, the impact of the immense adjustments made in campus life and the stress of the evolving world-wide COVID status, became apparent. To help mitigate some of the stress, in the course described here, the following course elements were implemented (when appropriate): flexibility on deadlines for assignments, modification of assignments to adjust for in-person elements that could not be implemented, a strategic plan to follow incrementally over the course of the semester to avoid getting overwhelmed, provided a method to earn class participation points if a lecture was

missed due to “life events” or COVID, students were given a week off from class after the midterm, in lieu of the fall break that was not given by the university in fall 2020.

Lastly, students were given the option to do a midterm do-over to improve their initial midterm score. The do-over served to replace the original midterm score. A second midterm was developed that was comparable to the original midterm and administered during the time when the class was given a week off in lieu of spring break. Students were asked to opt-in or opt-out of the do-over option. Students were given two weeks to decide if they wanted to opt-in or opt-out. Every student was required to indicate if they intended to opt-in or opt-out by completing a survey and checking the option that reflected their intent. Students opting-out indicated they wanted to keep their original midterm score. Students opting-in agreed to the following: 1) to taking the do-over exam, 2) the do-over score would replace the original midterm score, and 3) failure to take the do-over after opting-in would result in a score of zero for the midterm.

IV. FACILITATING PARTICIPATION AND ENGAGEMENT

Zoom was selected as the virtual platform to use for the course for its ease of creating breakout rooms for organizing students into virtual groups for group discussions. Students also self-reported having an ease with Zoom. For the following Zoom Experiences, students were randomly assigned to a breakout room (in most cases, at the beginning of the lecture). For each break out room students identify one person to be the scribe for the group. Each student is expected to participate and take ownership of their contribution (documented by the scribe). Scribe duties rotated among team members. If a person served as scribe in a previous group, they were not allowed to serve as scribe again unless everyone in the group had served at least once as scribe. The scribe is responsible for submitting the groups’ document detailing contributions of each group member and the groups’ deliverable. The scribe is also responsible for summarizing the group’s effort; however, everyone in the group is expected to participate in the class discussion once the breakout rooms are closed returning all members to the main Zoom session. The instructor visited each team to answer questions and/or clarify instructions.

Students were asked to indicate if they would recommend the activities using a 5-point Likert scale: 1) I would definitely not recommend, 2) I would not recommend, 3) I would likely recommend, 4) I would recommend and 5) I would highly recommend the activity. In the sections below, four Zoom Experiences are described.

1) *One-minute video.* The one-minute video is an adaptation of the “Minute Paper” concept. The Minute Paper is a very commonly used classroom assessment technique [6]. In this work, instead of writing a paper, students are asked to share and explain a concept from an assigned reading, they felt was a key takeaway. The assigned reading is available in the syllabus. Students are told at the beginning of the semester of the reading requirements and the expectation of reading the material before class. Students are randomly assigned to Zoom break out rooms, no more than three or four students per group (when possible). Each group is given a specific section of the

required reading to ensure each group would focus on a different aspect of the readings. Once break out rooms are occupied, students are instructed to discuss among themselves their key takeaways. To facilitate discussions, students were asked to answer the following questions:

Q1: What was the most important thing you learned from the assigned reading?

Q2: What do you feel, all students should know and understand after reading the assigned reading?

Each student must choose a different concept. Students were given 10 minutes to create a 1-minute video/audio explaining a key concept of their choosing from the assigned section from the assigned reading. Students were asked to post their one-minute videos on the class discussion board during class. Once all videos are posted students are instructed to watch and post comments on at least five one-minute videos before the next class. Students could not provide comments on videos content from some of the one-minute videos could be included in the upcoming midterm. All videos were viewed by the teaching assistant and commented on if the chosen concept was misunderstood and/or misinterpreted in students’ videos.

a) *Students’ Likert-response to the one-minute video.* Students were asked to indicate if they would recommend the one-minute video exercise using a 5-point Likert scale: 1) I would definitely not recommend, 2) I would not recommend, 3) I would likely recommend, 4) I would recommend and 5) I would highly recommend the one-minute exercise. Students were also given the option to provide a written response. The comments are shown below.

Most students who provided feedback stated they would recommend this activity. The biggest complaint was not having enough time to complete the video. Students felt 10 minutes was too limiting for a one-minute video and suggested allowing 15 minutes to create the one-minute video. A total of 21 students provided feedback: nine students from section one and 12 students from section two. Table II shows 29% indicated they would not recommend the activity, 33% indicated they would likely recommend and 49% indicated they would recommend (29%) or highly recommend (10%) the activity.

TABLE II. LIKERT RESPONSES FOR ONE-MINUTE VIDEO (N = 21)

Likert responses	Total	%
I would definitely not recommend	4	19%
I would not recommend	2	10%
I would likely recommend	7	33%
I would recommend	6	29%
I would highly recommend	2	10%

b) *Student’s written responses.* Students were given the opportunity to provide written comments about the “One-minute video” experience. A sample of students’s written responses are provided below.

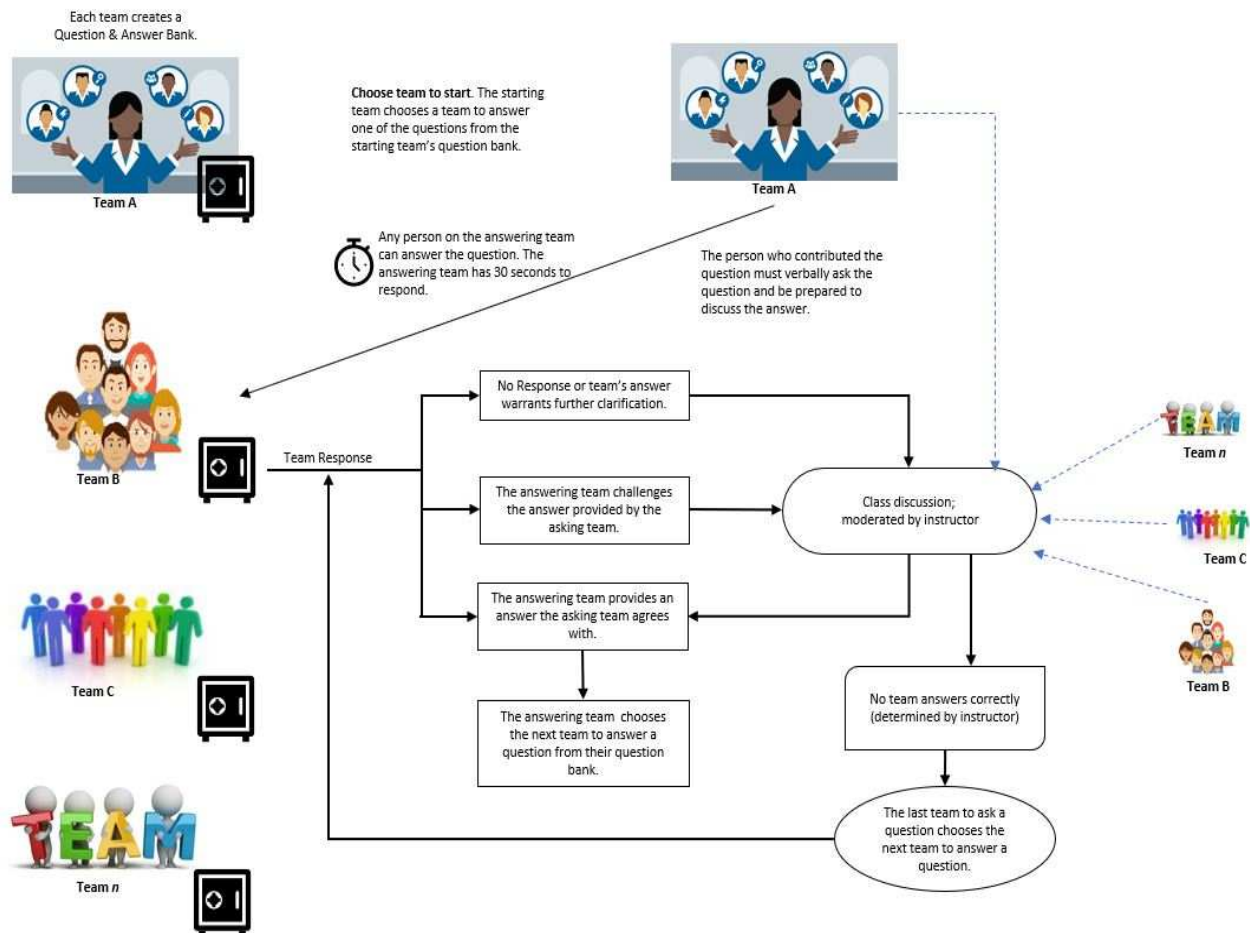


Fig 2. Lightning Round Zoom Activity

- The 1-minute audio/video explaining key concepts from readings was helped with the breakout sessions.
- I think this was a cool thing and I would recommend this for future classes because I think this helps the professors and TAs to find out how much of a topic a student understands.
- Dislike. I feel like 10 min is too limited for a 1min audio/video.

2) *Q&A Lightning Round*. For this exercise, the logistics are the same as described for the one-minute video. Students are given weekly reading assignments to be read before class. Students are randomly assigned to breakout rooms in Zoom. Each breakout room is assigned a specific section or chapter from the reading. Instead of creating a short video, each group creates a question bank. Each member in the group creates and contributes two unique questions (and the answers) based on the assigned reading they feel are key take-aways from the reading(s). Groups are given 10 minutes to develop their questions and answers. The scribe for each group documents questions and answers provided by each team member and submits the final list of questions and answers to Brightspace

for the group. Breakout rooms are closed after 10 minutes and students are automatically returned to the main Zoom window.

Once students return to the main Zoom window, the lightning round begins. Fig. 2 illustrates how the lightning round works. One team (The Asking Group) is selected to ask a question from their question bank (list of questions). They must choose one of the remaining teams (The Answering Group) to answer the question. The person who contributed the question must ask the question and provide assess the answer provided by the Answering Group. The Answering Group has 30 seconds to respond to the question. Any person from the Answering Group can answer the question. Three types of responses are possible:

R1: No response from anyone from the Answering Group.

R2: The Answering Group challenges the answer provided by the Asking Group.

R3: The Answering Group provides an answer the Asking Group agrees with.

Response-one (R1) and response-two (R2) will prompt a class discussion where all students are invited to discuss the question and possible answers. The Asking Group might be asked to clarify or elaborate on the question posed. The discussion is moderated by the instructor. If no team or student

provides a satisfactory answer (determined by the instructor), then the instructor revisits the concept(s) in more detail to address any misunderstandings students might have. If no student provides a satisfactory answer to the question, the Asking Group can ask the next question from their question bank. If the Answering Group provides a satisfactory answer, the Answering Group becomes the Asking Group in the next round and can choose from among the remaining groups to ask/answer a question from the Asking Group's question bank. This continues until all students have had an opportunity to ask at least one of their questions (or as long as course time permits).

a) Students' Likert-response to the Lightning Round. Table III shows 33% would likely recommend, 67% would recommend (48%) or highly recommend (19%) the exercise.

TABLE III. LIKERT RESPONSES FOR LIGHTNING ROUND ($N = 21$)

Likert responses	Total	%
I would definitely not recommend	0	0%
I would not recommend	0	0%
I would likely recommend	7	33%
I would recommend	10	48%
I would highly recommend	4	19%

b) Student's written responses. Students were given the opportunity to provide written comments about the "Lightning Round" experience. A sample of students's written responses are provided below.

- I did like this, as it meant that I was able to reflect on the reading and speak with others about it. I would recommend this for future courses.
- I liked this activity personally and I also think it's good for understanding concepts and other stuff presented in the readings.
- By allowing breakout rooms to facilitate questions and discussions in certain parts of the reading, the end product is one where everyone comes back together and shares their main takeaways from their parts of the readings.
- I did not like this activity, because I take a long time to come up with questions and it is hard for me to answer questions when other are giving their answer to the question.
- Even though I did not like this activity it did help reinforce the content we were learning. I would recommend this activity if more time to do the activity was given.
- This was a very good break out session. The class places a high importance on class participation and challenging the concepts in class and in the reading.
- This breakout room allowed us to ask questions that we had and hear other's opinions and perspectives on the matter which was very beneficial.

- I liked this. Gave a good chance to talk to others. I'm not sure what else could've been done better (besides others just lacking to do the homework)
- I liked this activity because you get to learn what the other person read and again it forces you to actually read the content and understand it.

3) Data Vis Bingo (Midterm Prep). For the midterm preparation and review session, a virtual bingo game was created. Virtual bingo cards can be created and used for free at <https://myfreebingocards.com>. The free version of the online game allows for up to 30 players at a time. Players can play virtual bingo on any device or print out their bingo cards. Bingo cards can be customized to include content of your choosing. For this exercise, bingo cards were created by replacing the traditional bingo numbers with things students should know for the midterm. Fig. 3 shows a sample Bingo card created for the course. The free bingo cards website provides a sharable link for students to connect and play. As the creator of the cards, the instructor's view includes the master board as well as simulated content to call out for students playing the game. As Fig. 3 shows custom phrases in the bingo cells are things students should know. The game is intended to help students identify what they know and what they need to spend more time reviewing before the midterm.

a) Students' Likert-response to the Data Vis Bingo Midterm Prep. Table IV shows 5% of respondents indicated they would not recommend this approach; however, 52% of respondents would likely recommend the exercise: 43% would either recommend it (19%) or would highly recommend (24%) the Data Vis Bingo game an in-class activity for midterm preparation.

TABLE IV. DATA VIS BINGO LIKERT RESPONSES ($N = 21$)

Likert responses	Total	%
I would definitely not recommend	1	5%
I would not recommend	0	0%
I would likely recommend	11	52%
I would recommend	4	19%
I would highly recommend	5	24%

b) Student's written responses. Students were given the opportunity to provide written comments about the "Data Vis Bingo" experience. A sample of students's written responses are provided below.

- I liked this activity; it was a fun game that helped identify my strong/weak points coming into this midterm.
- I like the Data Vis bingo as it allows the student to understand what they do and do not know and put it into a game format. It also motivates the student to remember the different square labels and that

incentives remembering what topics they should focus their studies on.

- I like it since it's very engaging.

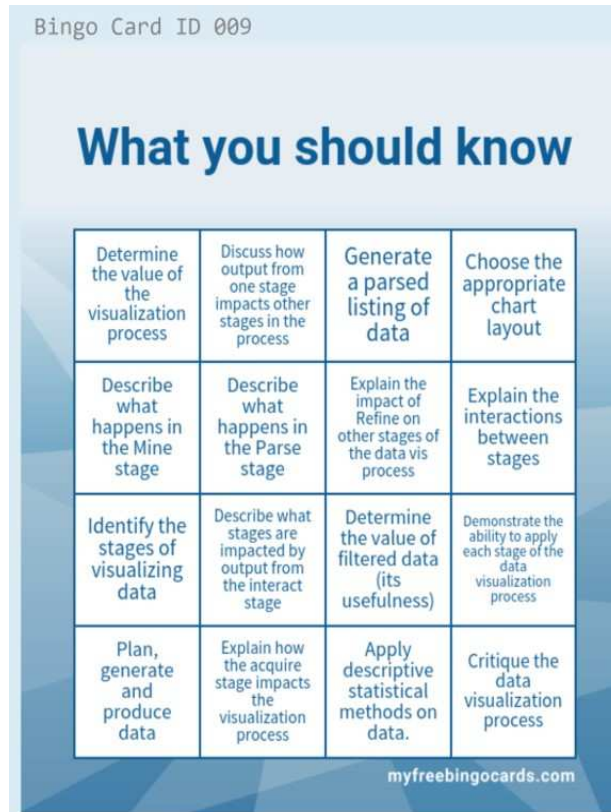


Fig. 3. Example Data Visualization Bingo Card

c) *Recommendations for improvement.* Students were asked to provide written responses with suggestions for improving the activity.

- I think a better way of doing it would be to have the spaces on the bingo board correspond to the answers to questions. E.g. the caller might say "The difference between a primary and secondary data source" and the space would have the actual difference written out, or "During this stage of the data viz process, we break up data into meaningful categories..." and then on the bingo card the answer would be "Parse". This helps us to better know what we do know and what we need to review for an exam.
- When a student has Bingo, they should be required to explain the concepts. For example, if a student says they can explain what happens in the mine stage, they should be asked to verbally explain it.

4) *What's wrong with this visualization?* For this exercise, students were randomly assigned to breakout rooms. Each group was given a different visualization to examine and discuss what was wrong with the visualization based on best practices for visualization covered in class and in readings. Each

group was tasked with making recommendations for refining the visualization. Teams were given 10 – 15 minutes to examine the visualization and answer the following questions as a group:

1. Describe the visualization.
2. What's wrong with it?
3. What should have been done? Make recommendations for how to improve it.

Visualizations contained obvious but sometimes overlooked issues like misleading labels and headers, nested charts, parts that don't add up to a whole, as well as visualizations that do not provide any insight. Visualizations provided to students for this exercise were acquired from [7].

After the breakout sessions end students are returned to the main Zoom session. Each group is asked to share the visualization that was assigned to the group with class. One person from each team (the scribe) shared their screen in Zoom and provided an overview of the group's assigned visualization. One member from the team is responsible for highlighting what the group agreed was wrong with the visualization. All team members could voice their recommendations for improvement with the class. After the group's presentation of the visualization and their recommendations for refinement, the floor was open for further discussion with the class. This allowed the entire class to see a variety of visualization issues and think about how to correct or refine them. More importantly, students see what "not" to do when creating their own visualizations.

a) *Students' Likert-response to "What's wrong with this visualization?"* Table V shows 100% of respondents indicated they would recommend this approach: 19% would likely recommend it, 57% would recommend it, and 24% would highly recommend the exercise.

TABLE V. WHAT'S WRONG WITH THIS VISUALIZATION LIKERT RESPONSES ($N = 21$)

Likert responses	Total	%
I would definitely not recommend	0	0%
I would not recommend	0	0%
I would likely recommend	4	19%
I would recommend	12	57%
I would highly recommend	5	24%

b) *Student's written responses.* Students were given the opportunity to provide written comments about the "What's wrong with this visualization" experience. A sample of students's written responses are provided below.

- I feel like this activity would be good in helping identify parts where visualizations can be improved upon.
- I think this is a good activity because it helps students distinguish from good visualizations and bad visualizations.

- This was a good way for students to solidify their understandings of what features should or should not be included in a visualization.
- It was also nice to hear from people that have different perspectives as it is an important part of creating visuals as our viewers are diverse and will all have a different perspective on what we create.
- I liked this activity because it allowed us to use the concepts we learnt in class and apply and discuss them with ourselves (breakout groups).
- It's a good way for us to tell what need to be done for a data visualization to be intuitive and what could we do better.
- I liked this. Gave a good chance to talk to others. I'm not sure what else could've been done better (besides others just lacking to do the homework)

c) Recommendations for improvement. Students were asked to provide written responses with suggestions for improving the activity.

- I recommend having an allotted time for feedback from other groups after the main group is finished presenting how to improve their visualization. For example, if the main group says that the visualization can be improved in terms of clarity and accuracy, another group can add that adding labels can help in this regard.

V. RESULTS

The Zoom Experiences presented in this work utilized Zoom Breakout rooms to facilitate small group discussions. Randomly assigning students to Breakout rooms allowed students the possibility of meeting different students in each session. Students were asked to provide feedback on how they felt about the use of Breakout rooms using Zoom. Overall students' response to the use of breakout rooms was positive. Written comments reflected what students liked/disliked about the breakout room and also highlighted challenges that are present irrespective of platform and delivery.

- I think breakout rooms are good for things where a discussion of already completed work is to take place. In this case, they are useful since there are fewer people in a room so that people don't talk over one another. However, when the goal is to do a new assignment, it often feels like pulling teeth to try and get people to speak up and participate.
- I generally like it because I have an easier time expressing my thoughts and ideas in a smaller group environment and I also feel it's a good way to get to know your classmates better.
- I do not like that sometimes you do not have enough time or too much time to do something in the breakout room.
- I like the breakout rooms a lot. It gives us a better chance to discuss our thoughts on the content in a

smaller group which is easier in this online setting as there are less people trying to talk over one another.

- I wish there was some way to communicate to the teacher much more easily like through chat, rather than wait for the teacher to come to the same breakout room session.
- I think they're helpful because it helps me learn what other people think of the discussion topic we've been given.

VI. DISCUSSION

As with any new approach, exercise or class assignment, some students like/dislike the Zoom Experiences presented in this work, for various reasons. The goal of the experiences was to foster class participation and engagement of students. The teacher/student relationship requires effort from both sides, and there are tradeoffs. In this work, considerable effort was made to engage students in the online environment that required a more active role in class discussions. Results indicate students found the "Lightning Round" and the "Data Visualization Bingo" game to be most engaging. We suspect these activities were highly favored due to the lack of reported engagement in other classes students were enrolled in. In written responses, students reported:

- "I liked the actual attendance of the lectures. My other classes only had pdfs or like lecture videos that didn't explain much until I did some of the homework problems. But this class actually allowed me to learn even if it was virtual."
- I liked the class participating and engagement guidelines because I think it allows the Professor to know how students are doing in his/her class.
- "In my other classes I haven't been able to talk with others in the class, but with this class I have been able to communicate with my classmates."
- "I find it hard to communicate online as it is hard to tell when someone else is about to talk. I also do not formulate my thought very fast, so sometimes I feel I do not have enough time to come up with an answer to a question."
- "I liked the engagement and participation because it allows us to not be lazy and actually attend the lectures. I also feel closer to the professors better this way rather than just watching a video."
- "The class is very activity focused which is great and provides a lot of hands on experience but takes up a lot of time and with technical difficulties."
- I think the general trend for all my answers to this are that activities that require action on the part of the student need to be assessed with empathy for the challenges associated with technological and environmental disparities.
- I think the paradigm of show/explain something in class, and then have students complete something out of class worked well whereas things which required large

commitments on the part of the student during lecture were less successful.

- I think the use of break out rooms is a good way to foster participation but may be hard to monitor for the levels of participation from individuals.
- I liked the way we did the activities and the usage of Zoom.

The approach was not without its challenges. Some students reported finding the timed exercises “difficult to provide a specific point or give my thoughts because I found the content to be moving a bit too fast,” or students not reading the material before class thereby not contributing to the group discussions. This element is, in fact, hard to monitor. Students who are used to a passive learning environment are harder to engage. One student reported, “Some activities I didn't like, but I found them necessary to prove our understanding.”

The instructor visited each breakout room in a “Round-Robin” fashion to answer questions or clarify concepts. This required constant switching between groups and keeping track of time to ensure all teams were visited before the assignment ended. There was no easy way to allow the TA to visit each group since only the host had the ability to move between groups. Another challenge was figuring out how much time to allow for each group activity. Although developed for the online environment, the exercises will be revised and edited for in-person instructions in fall 2021. Future implementations will include feedback provided by students.

The techniques presented offer various ways for engagement in a synchronous classroom environment which allows for real-time participation with and from students. These techniques lack schedule flexibility, individual dictated pace and more time with course material as afforded by asynchronous classes. To address the sometimes fast-pace of the techniques, all learning materials and artifacts (breakout room notes, students’ comments) were made available on the course webpage for self-study and review. The techniques implemented were intended to simulate a more immersive classroom online experience. In an asynchronous learning environment, direct teacher-student, and/or student-student communication is absent. Students who enrolled in the course enrolled with the expectation of having some form of interaction with the teacher and other students. It would have been difficult, if not impossible, to interact with students in the ways described here in an asynchronous classroom setting.

VII. CONCLUSION

A variety of delivery methods were explored to enable students to connect the dots between the material and the underlying course content presented in a non-traditional way. Some activities were well received by students some were not. One student reported, “The online lectures are the only lectures that have utilized the Zoom breakout meetings function in the classes I am enrolled” in for fall 2020.

Activities described in this work require active participation of students and fosters a sense of investment, by the student, in the class. Students who actively participated were able to assess their own efficacy of course content by identifying unclear concepts that could be clarified before the midterm. More participation and engagement enabled students to assess their performance on in-class and homework assignments and plan accordingly for the final exam. There is room for iterative refinement and improvement for all of the Zoom Experiences presented here. The Zoom-enabled practices described in this work can be adopted for any course and adapted as needed for various modes of delivery.

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