

Successes, Expectations and Challenges Associated with In-person to Online Remote Transition of an Engineering Statics Course

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Continuing education amidst the ongoing COVID-19 pandemic has been one of the most daunting experiences for most students. As the virus continued to spread across the country, various school districts and localities faced mounting pressures to close school facilities. College students were asked to leave campus and finish the semester remotely, placing them in an unfamiliar learning situation. When several campuses reopened in the fall 2020, outbreaks raced through dorms and infected thousands of students and employees. More than 120,000 cases have been linked to American colleges and universities since January 1, 2021, and more than 530,000 cases have been reported since the beginning of the pandemic¹. Rising mortalities, economic lull, and the uncertainty due to sudden closures led to increasing cases of depression and anxiety among the students. The vulnerable student population was falling behind even further and finding it increasingly challenging to keep pace.

In light of COVID 19 several restrictions were imposed on the normal functioning of educational institutions such as setting limits on student movements and their congregation on campus, as in food courts and dorms, cessation of athletics and other nonacademic student activities; adoption of remote teaching models or teaching in-person with a reduced class capacity, limiting or suspension of academic research, adoption of mandatory face mask policy on campus and social distancing. The transition was not easy for many students. The detailed impact of this transition to digital learning will only be revealed in due course with the passage of time.

The short-term impact of the sudden breakdown in academic structure was a drop in student enrollments in courses, drop in college applications, compromise on the academic integrity of the online tests, widespread student and faculty struggles in coping with the sudden technological changes, experiencing the bureaucratic rigidity and the constraints to changing the established framework of rules, and the ensuing dissatisfaction. The need to adapt to the prevailing circumstances led to retooling the academic business model and structure by adopting countermeasures that included waiving standardized test requirements and waiving or reducing tuition or admission fees².

In order to gauge the successes and the challenges on the lower classmen engineering students, at Rowan University, a couple of surveys were conducted during two stages in the fall semester of teaching. The underlying objective was to identify the instructional benefits and challenges, document learning successes and failures, and assess adaptability of faculty and students to a hybrid mode of course delivery.

A survey was conducted asking the students to compare their experiences from prior semesters with the current one and provide their feedback on things students found challenging/not working well and what improvements/changes would make a greater impact on them. The survey probed the following: (1) students' understanding of the course material (in terms of level of easiness or difficulty) (2) experience with in-person classes versus remote instruction (in terms of class load, degree of satisfaction with instruction received, and technical challenges such as hardware, connectivity, instruction delivery platform, etc) (3) effect of surrounding environment (living arrangements in previous versus post COVID environment) (4) availability and use of resources (instructor office hours, group work, learning materials, tutoring, etc).

In this paper we describe the efforts undertaken and the survey results.

Literature review

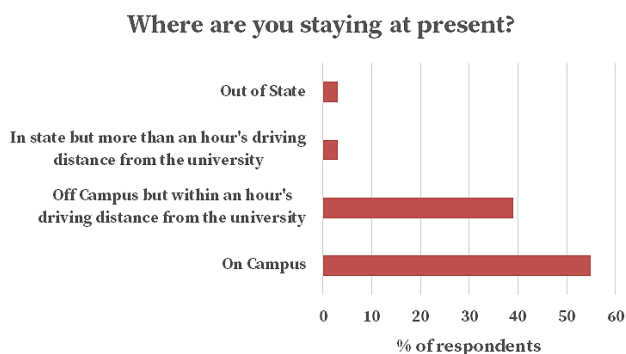
As part of the response to COVID, various initiatives were taken by universities to adapt to the restricted learning environment^{3,4}. This include creating a remote Mechanical Engineering Summer Undergraduate Research Program to engage students in active research and to provide a mentored experience for independent research work. Students were matched with faculty based on their fields of interest and were required to participate in a workshop series on research methods, scientific writing, career planning, and professional development⁵. Another attempt at asynchronous online delivery of remote introductory physics lectures used the Playposit technology which is an interactive audio (MP3 listening assignment) and video (MP4 viewing assignment) components⁶.

Some of the challenges that have been reported include financial strains placed on the students. In one study of 1008 students sampled nationally in early December 2000, over half of the students said they had to make purchases, such as computers, microphones, or desks, with 70 percent stating that these purchases came at a significant cost. In this same study, 60 percent of respondents indicated that having access to stable, high-speed internet access was a challenge⁷. In engineering education in particular, the recognition of a critical need for universal internet access has been noted⁸. Methods of course delivery have been challenged, with many academics adapting their teaching methods to include live lectures via Zoom and pre-recorded practical work. Some professors have shifted the focus to making learning more intuitive and interactive, striving to keep students engaged⁹.

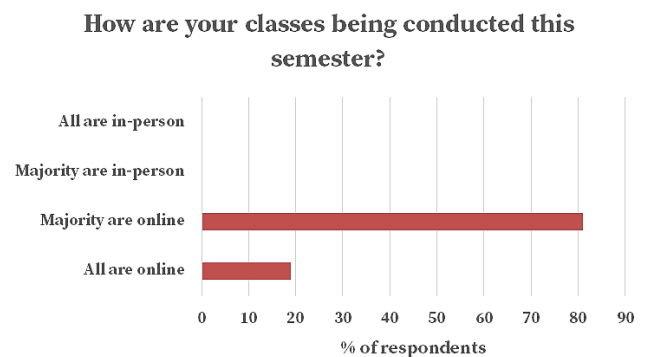
Discussion

One of the courses that the instructors were teaching in the Fall 2020 semester was Statics. We decided to take a preliminary survey to get an idea of the student's preferences regarding the delivery of the course content. The following questions were asked on the survey

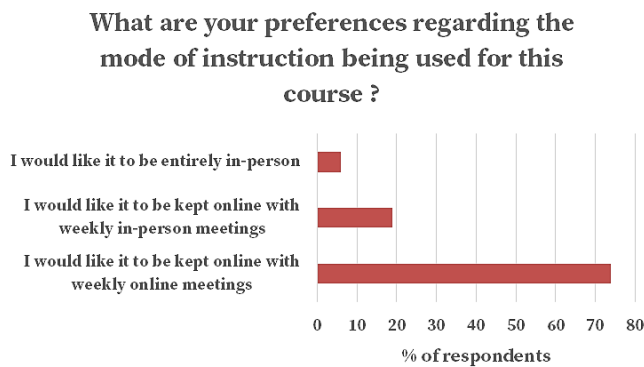
1. Where are you staying at present?
 - On Campus
 - Off Campus but within an hour's driving distance from the university
 - In state but more than an hour's driving distance from the university.
 - Out of State
2. How are your classes being conducted this semester?
 - All are online
 - Majority are online
 - Majority are in-person
 - All are in-person
3. What are your preferences regarding the mode of instruction being used for this course?
 - I would like it to be kept online with weekly online meetings
 - I would like it to be kept online with weekly in-person meetings
 - I would like it to be entirely in-person
4. How well is the online mode of instruction working out for you?
 - Able to follow, no major issues
 - Able to follow but major difficulties/issues.
 - Unable to follow, need in-person instruction



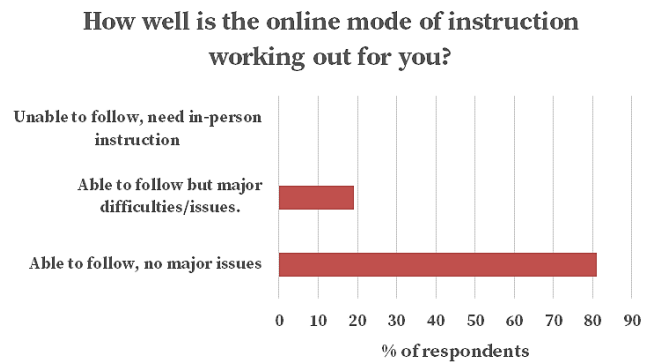
(a)



(b)



(c)



(d)

Figure 1. Results of the initial poll related to (a) residence (b) enrollments (c) preferences regarding mode of instruction and (d) comfort level with online mode of instruction.

The initial survey results are presented above. They indicate that at the beginning of the semester the majority of the students wanted the classes to be kept online, had no major issues following the course, were taking majority of their classes online and they were either staying on-campus or within an hour's driving distance from the university. The students initially felt comfortable with the online mode of course delivery with weekly online meetings. This shows a sense of fear and the desire to make adjustments in their learning environment in order to cope with that fear. Though this survey did not probe in detail important factors such as their living arrangements and caregiving responsibilities (for example a family member affected by the pandemic), their financial insecurities, the impact on their college plans (for example those graduating), and their health conditions, it is reasonable to assume that the sudden onset of the pandemic and the online transition of teaching certainly added to the challenges of their student life. Majority of the students had smartphone, laptop or computer and internet access at their residences. The university had also helped about 7% of them arrange the necessary technology. This justifies their comfort level in adjusting to the new mode of course delivery.

The course delivery was both synchronous and asynchronous at times depending on the number of students displaying an interest in showing up for the classes. About 25% of the course material was delivered synchronously while remaining 75% was delivered asynchronously. The course content consisted of the following:

1. Weekly assignment of 3-4 video lectures. These lectures were a mix of instructor recorded lectures as well as lectures available online on YouTube. The topics covered were Units and Dimensions in Statics, Vectors, Forces (2D and 3D), Moments (2D and 3D), Equilibrium (2D and 3D), Trusses

(Method of Joints, Method of Sections), Frames, Distributed loading, Moment of Inertia and Centroids.

2. A weekly quiz and homework
3. Online meetings with the students using WebEx or Zoom.

The student progress throughout the semester was not very different as compared to their performance in a normal semester. The main issues faced by the faculty were

1. Struggling to keep up with the lecture posting deadlines. Video recording and processing took an average of twice the amount of time it would take to present the lecture in a classroom times a typical classroom lecture took
2. Designing the quizzes and homework on the online learning management system. While one of the instructors used WileyPlus, the other instructor used CANVAS. Since Wiley Plus has a test development suite inbuilt, in which the questions need to be selected, the CANVAS involved manually entering the question pool. Both the quizzes and the homework were automatically graded.
3. Developing the online exam followed by online grading. The challenge to make sure that the students were not collaborating with each other on their exams was daunting. The instructors worked out a temporary fix by using a question pool method where no two students would get the identical question set. Also the exams were timed to be released for a certain time window on the exam date, thus reducing the chances of a compromise on the testing integrity.

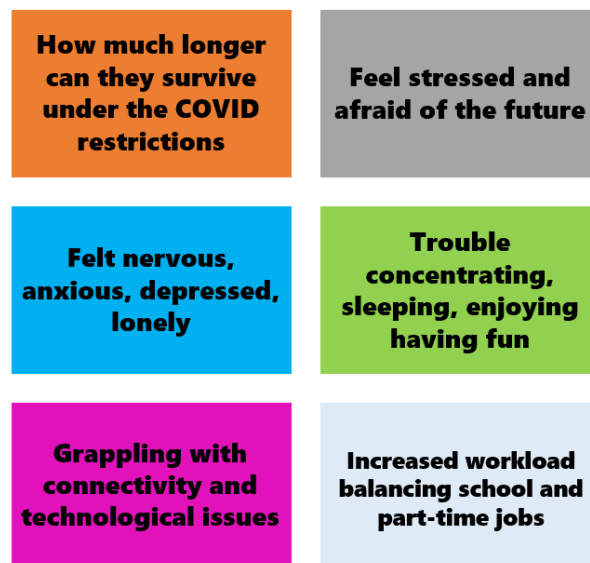


Figure 2. Common issues faced by the undergrad student population during the COVID

The challenges for the students were (see Fig 2)

1. Coping with the increased workload and working around their schedules and conflicts
2. Grappling with connectivity and technological issues. Sometimes CANVAS would not display images or the servers would be down. This often resulted in a late submission of their assignments.
3. Difficulty in following the synchronous lectures due to poor audibility or visibility of lectures recording/capture equipment in the classrooms such as camera and microphones or even low resolution and poor focus.
4. Dealing with COVID on either campus, or at their residences or in their families. Quite a few students became ill and fell behind in the class.

Less than half of the faculty at this university had ever taken an online course let alone teach one before they were asked to convert their traditional in-person classes into remote classes. The rush to get classes online wasn't welcomed as it did not give the faculty adequate time to prepare to transition to remote teaching. Nearly half needed additional academic and/or technical support.

Results

Unlike transitions that happen under normal circumstances, such as from face-to-face teaching to blended, online or flipped classrooms, the changeover in the present case to remote teaching was brought about in haste, in a sudden and an unplanned way under the prevailing emergency situation. Instructors had to swiftly develop an entirely new teaching strategy, often having to make a choice among various digital teaching and learning tools with different capabilities and support available to them all while balancing their workload. Some of the technology that both the students and the faculty had to struggle with were content management systems, message boards, a deluge of emails, lecture videos (synchronous or asynchronous), videoconferencing or real-time collaboration systems, instant messaging, and other tools that involved changes in the assessment activities or criteria.

Towards the end of the semester another survey was solicited from the students regarding their experiences with the teaching. The questions on the survey were

1. Overall how do you feel the way classes were conducted this semester?
2. What was your experience with teaching and learning this semester?
3. Please rank the following according to their effectiveness on your ability to learn course material this semester?
 - Online Live Lectures
 - Face to Face Classroom Lectures

- Pre-recorded Videos
 - Documents related to the Course Materials (e.g. Lecture PPTs, Docs, PDF's)
4. How did your physical presence/absence affect your access to the following resources:
- Use the library
 - Use classroom space
 - Access to a tutor/course instructor's office hours or personal meetings
 - Communicating/Working with your classmates
5. How were the following course components handled during this semester as compared with the previous semesters?
- Grading and Class Performance
 - Online assignments and Exams
 - Addressing the students' questions, and concerns

The results are presented below

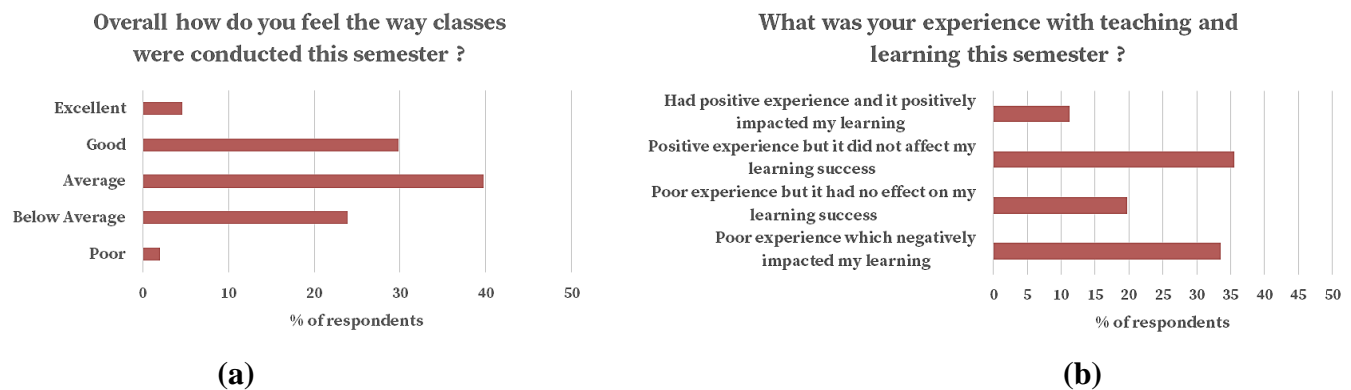


Figure 3. End of semester poll results related to (a) conduct of online classes (b) learning experiences

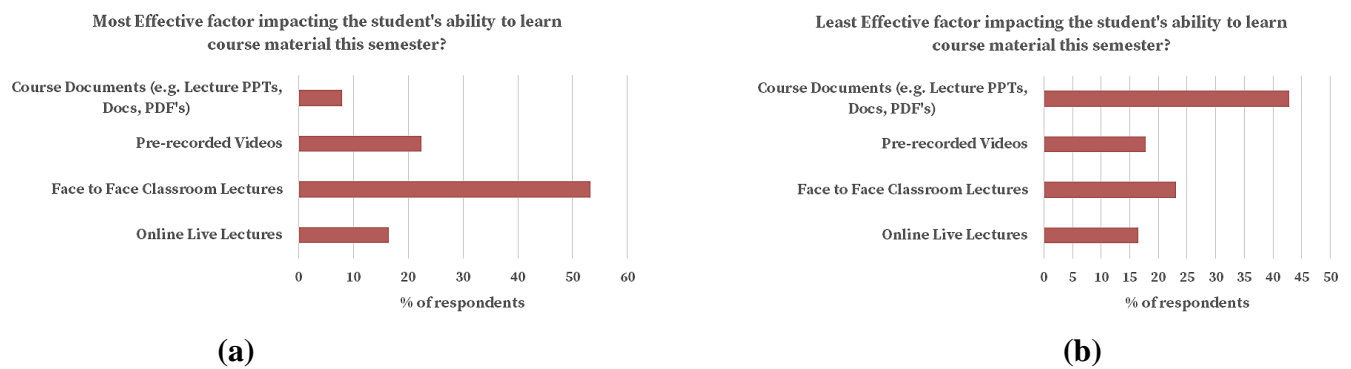


Figure 4. End of semester poll results related to (a) most effective and (b) least effective factor impacting the students' ability to learn the course material.

The above results point to the fact that overall 40% of the student's felt that the classes were average Figure 3(a). 30% felt the classes were good while roughly 25% felt that it was below average. The split between positive and poor experience was almost equal (see Fig 4), around 35% each, Fig 3(b). The most impactful factor that helped student's to learn were face to face lectures (55%). The other options such as pre-recorded videos and online lectures were more or less equally split. The least important factor contributing towards the ability to learn as per the student's was the course documents (45%).

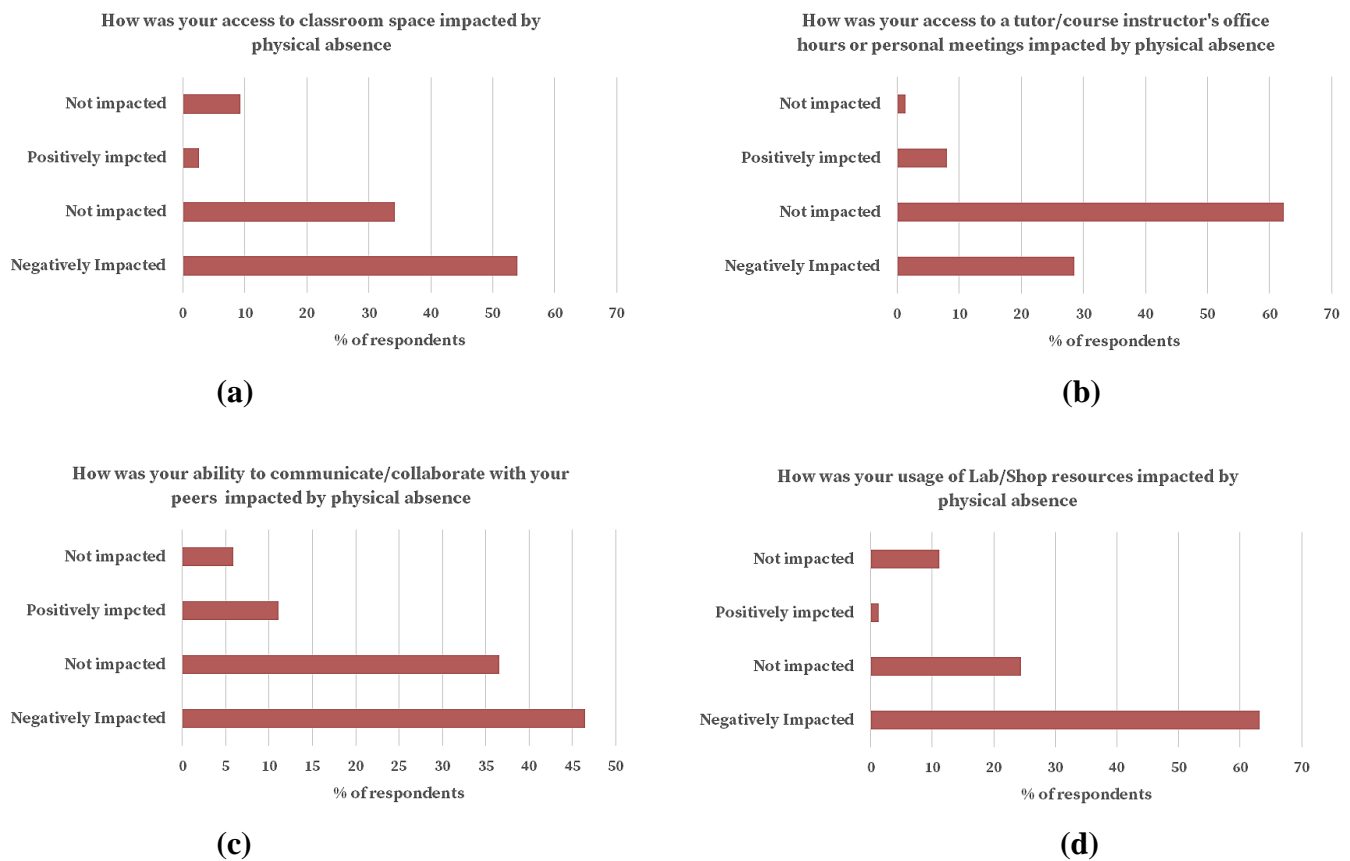
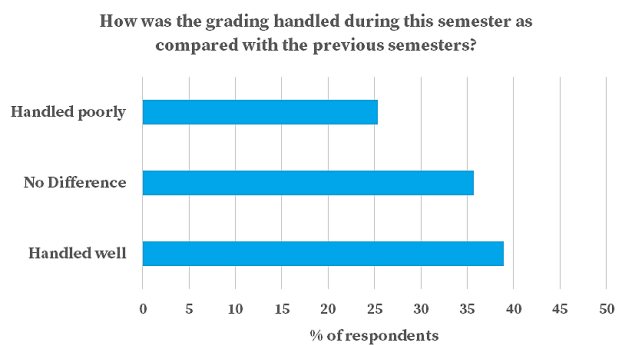
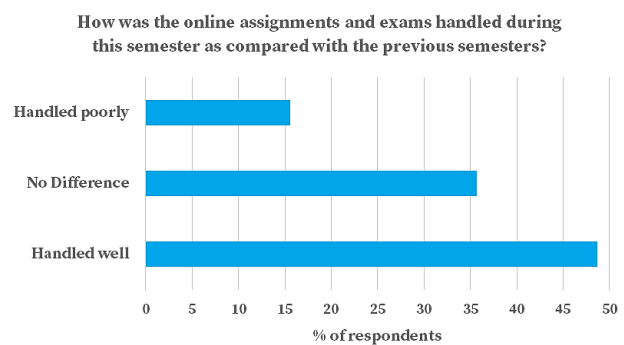


Figure 5. End of semester poll results related to impact on (a) classroom space (b) access to instructors office hours (c) communication and collaboration with peers (d) use of lab/shop resources.

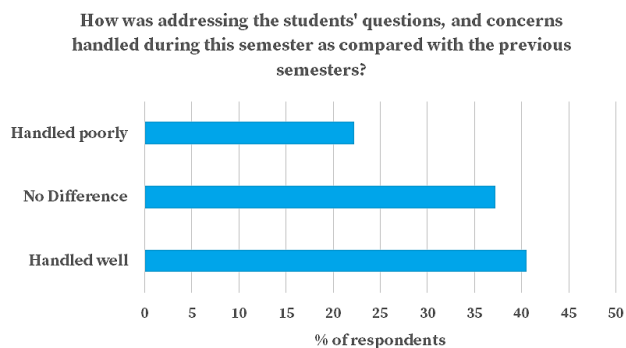
The poll on which course component was impacted the most due to the sudden transition had the following outcomes, Fig 5. Access to classroom space was negatively impacted mainly due to restricted entry in to the college buildings. The access to the instructor wasn't impacted. The other heavily impacted component was the peer interaction. Due to the remote nature of the course the students were unable to communicate effectively with each other. The lab components in various courses in this university is a big factor that students enroll for. This was one of the most impacted COVID outcome at 65%.



(a)



(b)



(c)

Figure 6. End of semester poll results related to the students feedback on (a) grading (b) assignments and exams and (c) handling students' questions and concerns.

Here the students mostly felt that the grading was handled well (Fig. 6a), the assignments were handled well (Fig. 6b), and their questions and concerns were handled well. (Fig. 6c)

We also collected the student evaluations on the course. The tables below present the positive and the negative comments from the students.

Table 1. Positive Student Comments from Fall 2020 Statics Course

Section 1
It was a little tough because it was online but the videos help and then working through problems during class time was great.
Great communication on lesson objectives. Providing the power points allowed me to compare my work to the requirements assigned.
The instructor began each lesson with an outline of what was intended for the day. Very helpful for note organization.
While COVID restrictions made this class a lot more challenging to me, I did find the class to be doable and enjoyable.
The instructor often asked if the method of instruction was working or if it wasn't. The instructor was open to any feedback the students had.
Section 2
Posted good material on YouTube for students to watch. Put all videos in one playlist for easy access.

The problems in quizzes and homework were challenging and promoted students to think about geometry.
This course prepares you for other courses in the future, but it also directly applies to many other analysis in personal and professional life.

Table 2. Negative Student Comments from Fall 2020 Statics Course

Section 1
The instructor used recorded lectures to teach the class. Instructor hosted a live one hour session to answer questions and go through example problems which did help a little bit.
The videos and in class problems taught you what you needed to know. However, in some homework I had to teach myself minute details.
Everything was taught well under these circumstances except centroids. I felt the videos were not helpful enough and I had to teach myself.
All work was done through a homework website, so feedback was only given on tests.
Obviously feedback was lacking on the Wiley Plus assignments because they were automated, but the midterm feedback was helpful.
Engagement in online class is difficult.
Section 2
Inconsistent in posting lectures, homework and quizzes.
It would have been nice to have worked with other students in groups to solve problems at some point.
Concepts were not well explained and questions were always hard to ask.
Some of the explanations in videos operated on the assumption that students understood content conceptually, but often simply following the formulas left me confused.
On the quizzes and homework, only the final answers were submitted; this means instructor had no access to our work, he could not give us feedback, and there could be no partial credit. This lack of feedback left me confused throughout the semester as to why I wasn't getting the right answer.

Conclusion

In this university the First-Generation College Students (FGCS) make up more than a third of the undergraduate student population. FGCS come with many strengths that enable them to succeed in their college education. However they also face some significant challenges. While several of them may have strong motivation and aspiration to pursue college, the determination to persist during rough times might take a setback. A national crisis such as COVID exposes the vulnerability of the student population. From the results presented here the students mostly felt that the grading was handled well, the assignments were handled well, and their questions and concerns were handled well by the teaching faculty. The loss of lab-component was the most impacted factor in transition to online mode of instruction. Peer interaction which is an essential component of educations was also impacted significantly.

While some are definitely facing difficulties learning the subject others seem to have adapted themselves fairly quickly and conveniently to the change in the pedagogical transition.

Future work

It would be helpful to analyze the effect of the sudden move to remote teaching by collecting quantitative data of academic records, instruction-related variables such as class size, synchronous/asynchronous delivery, and use of supporting technologies, on students' academic performance across all undergraduate courses.

The authors acknowledge the help provided by Dr. Amir Miri towards the development of the survey used in this study. They are also grateful for the support received from the Mechanical Engineering Department at Rowan University.

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