

Teaching and Educational Methods

Adaptation of Teaching Strategies During the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic forced drastic changes in teaching methodologies, shifting from in-person courses toward fully online platforms. This article presents teaching strategies used to modify two traditional face-to-face courses (Economics of Resource Use and International Agricultural Trade) and one synchronous online course with in-person review sessions (Quantitative Methods in Food and Resource Economics) into an entirely virtual setting. This article discusses the challenges of moving content online while maintaining interaction with the students. It also exposes significant factors that have become impending challenges for online instruction during the pandemic. This study also examines students' perception of their learning experience. Using a paired comparison test, academic performance was evaluated before and during the pandemic, showing that teaching methodologies implemented in the three courses were able to keep students' engagement throughout the spring semester. These methodologies sought to provide a personalized approach and keep students engaged in the lectures. Further, this study discusses the impact of the pandemic on the students' perception of their learning experience.

1 Introduction

In 2018, the U.S. Department of Education estimated that about 35 percent of college students took at least one online course during their career preparation (Lederman 2019). The shift toward online instruction has been accelerated since mid-March of 2020 due to the coronavirus (COVID-19) pandemic (Kiesel et al. 2020). To comply with the stay-at-home regulations, universities around the globe migrated from traditional in-person courses to online education (Crawford et al. 2020).

In a short period of time, instructors modified their original content to teach classes virtually either *synchronously* (using telecommunication software) or *asynchronously* (pre-recording classes so students could access them at any time). These modifications limited instructor-student interaction. To overcome this challenge, some instructors used online websites, discussion boards, and online office hours. Nonetheless, many students experienced disrupted learning activities; for instance, they migrated to other states and countries. These events further exacerbated students' stress, especially those who had difficulties with internet access and proper study space (Bao 2020; Castle 2020; Melo et al. 2021).

To investigate how instructors and students faced the pandemic challenges, we used three undergraduate-level courses in agribusiness taught during spring 2020 as case studies. We discuss the teaching methodologies implemented to enhance their learning experience. Two of the three courses were traditional courses delivered in a small classroom setting that switched from in-person to an online learning environment. The third course was an asynchronous online course with in-person revision sessions and office hours, which remained online using the same teaching methodologies; however, the in-person activities were substituted by synchronous sessions, including synchronous review sessions and remote office hours.

We contrast learning under two scenarios: before and after the shift toward a fully online teaching environment. The teaching tools are based on methods presented in Peña-Lévano (2020) and were modified to be used in multiple types of courses at any education level. The study reveals that

adaptations to teaching methodologies, including synchronous review sessions, prompt feedback of graded assignments, and constant communication with the students, were crucial for helping students face the transition of instruction during Spring 2020. Undergraduate students in the three courses responded positively to these efforts. Their willingness to stay engaged in the class activities was vital for their academic success. Nevertheless, many students expressed that not working with their classmates was a major stressing factor.

This study exposes lessons from pre-pandemic online and pre-pandemic in-person courses to have a more comprehensive understanding of the potential effects of the pandemic on students learning, even among those enrolled in online courses before the pandemic. It also investigates important external factors that affect the students' academic performance. This research article discusses and addresses several important questions that have emerged during the COVID-19 pandemic: (1) What are the significant challenges encountered by the students that affected their academic performance during the pandemic?, (2) How can the instructor motivate active learning in both synchronous and asynchronous learning environments? Specifically, what methods can be effective in a virtual setup that could mimic the face-to-face environment when teaching analytical and mathematical tools?, and (3) Does the implementation of different teaching strategies (i.e., online review sessions, asynchronous presentations, among others) help online instruction and students' academic performance? Thus, this paper presents several methods to promote active learning and students' engagement in class during the pandemic.

As of November 2021, many colleges across the globe have continued with the online modality due to the spread of different COVID-19 variants across the world. However, online instruction faces five main barriers, which have been emphasized in our study, and it is consistent with the literature. First, the successful delivery of online courses is challenged by the lack of (in-person) interaction with the instructors, especially for large classes that offer laboratories and have field trip experiences (Deming 2020; Melo et al. 2021). Synchronous courses had difficulties motivating students to participate during live sessions, especially those with limited internet connections or preferring not to use a camera during class (Deming 2020). Second, many instructors were required to move face-to-face courses to online formats on short notice, adding substantial time commitments in order to learn online tools and prepare these materials (Marcus 2020). Third, online instruction involves self-directed learning; the success of this method depends on the structure, design, and attractiveness of the lessons (Drange, Sutherland, and Irons 2015). Self-learning is challenging to achieve when students do not feel motivated or engaged in the material. Fourth, upper undergraduate courses in agricultural and applied economics often involve computer software for simulations or data analysis. Students receiving online instruction may face external technological constraints such as access to computer laboratories, familiarity with operating systems, or issues with software versions (Perreault et al. 2002; Peña-Lévano 2020). Finally, students faced stress associated with moving from their apartments and/or houses in traditional on-campus cities during the semester. Students also expressed concerns about lack of a proper learning environment and not having social interactions with their peers (Klass 2020; Melo et al. 2021).

2 Background

This article illustrates adaptations of teaching methodologies during the pandemic. We focus on three upper-level undergraduate courses taught by one of the authors, including two pre-pandemic in-person courses: International Trade Policy in Agriculture and Economics of Resource Use, and one pre-pandemic online course: Quantitative Methods in Food and Resource Economics with in-person sessions. The inclusion of this last course was intentional to evaluate whether students learning response to methodologies was different between online and in-person courses. These three-credit courses (described in Table 1) were offered during Spring 2020 at the University of Florida as part of the core curricula of the agribusiness major.

Table 1. Core Undergraduate Courses Described in this Study

Class Code	Course Name	Description	Imparted at
Deliver Pre-Pandemic: Fully in-person			
AEB 2451	Economics of Resource Use (Junior level)	<ul style="list-style-type: none"> • Focuses on understanding the effect of human actions on agricultural sustainability, environmental degradation, and the use of natural resources. • Topics include environmental policy, externalities, open resources and public goods, pollution control, and environmental analysis tools. 	Plant City <i>(This course was open to Agriculture Education students)</i>
AEB 4242	International Trade Policy in Agriculture (Senior level)	<ul style="list-style-type: none"> • Examines the economic forces that influence the international trade patterns between the United States and other countries. • Designed to have active discussions related to real current events and policies, including the Farm Bill, domestic labor and environmental regulations, international treaties, multiregional agreements, and trade barriers, among other topics. 	Plant City
Delivery Pre-Pandemic: Online course with in-person review sessions, computer lab, and office hours.			
AEB 3510	Quantitative Methods (Junior level)	<ul style="list-style-type: none"> • Topics include systems of linear equations, matrices, multivariate calculus and integration, sequence and series, linear programming, and computer simulations of economic problems. Pre-recorded lessons were posted on the online class platform. • For details about this course, please see Peña-Lévano (2020). 	Gainesville Plant City

2.1 Methods in the Traditional In-Person Courses

Face-to-face classroom settings allow for student-teacher interaction, in which the learning process and student engagement largely depend on the instructor’s pedagogy (Kuh et al. 2006). Previous studies have shown that active student participation is positively correlated with academic performance (Carini, Kuh, and Klein 2006; Trowler 2010; Lei, Cui, and Zhou 2018). Taking these facts into account, four assessments were implemented in the two (traditional) in-person courses:

- 1) *In-class questionnaire:* Each weekly unit (i.e., chapter of a course) includes a questionnaire, which is a set of conceptual questions and problems covering the most relevant material of the unit. A sample can be found in *Appendix A*. This task is solved during the class session and submitted at the end of the week. This graded activity seeks to engage students as they must pay attention to the lecture in order to answer it correctly. This questionnaire also may serve as a study guide for the students.
- 2) *Oral presentations:* Students were asked to prepare three-minute presentations explaining the most relevant aspects of an environmental (or trade policy) issue, followed by a one-minute Q&A session. An evaluation criteria sheet provided guidelines on what is expected from this activity, including

suggestions regarding slides design, content, and letter size. A sample can be found in *Appendix B*. Dankel and Ohlrich (2007) showed that repeated presentations during a semester may provide positive results for students' critical thinking, communication, and oratory skills. Therefore, multiple short presentations were scheduled during the semester in which students also had the opportunity to interact with their peers and the instructor in the Q&A session.

- 3) *Final poster presentation*: Students were scheduled to present an assigned environmental (or trade policy) topic in a poster presentation during the last week of classes. Professors from the Tampa area were intended to attend the event and evaluate the presentations. The goal of this task was to improve the students' communication skills and their ability to summarize and deliver information in an effective manner.
- 4) *Field trips*: A visit was scheduled to a restored wildlife recreational park located in mid-Florida (i.e., Lake Apopka Wildlife Drive). Guides provided a tour showing the protected area and explaining the biodiversity found at the location. The staff also provided a workshop describing the restoration project and the preservation of the wildlife. This permitted students to associate the concepts learned in class in a real-life application that showed the impacts of environmental degradation and policies needed to preserve wildlife and restore natural habitats.¹

In summary, the four methodologies sought to promote active participation, interaction with peers and the instructor, and experiential learning,² which are key aspects to incentivize student engagement in class (Helme and Clarke 2001; Zepke, Leach, and Butler 2014).

2.2 Modification to the In-Person Courses

The pandemic forced sudden changes in the teaching methodology for the courses. Rapid modifications were implemented during mid-March to ensure a positive learning experience despite the external challenges faced by the students. Lectures of the in-person courses were offered then synchronously online via Zoom at the same class hours. The usual teaching methodologies for the in-person courses were adapted to these conditions as follows:

- 1) *In-class questionnaires* were now conducted during the online sessions. The instructor discussed the class material while sharing on his screen the PowerPoint presentation. Any mathematical procedure was taught using a desktop camera, where the instructor solved the problems on paper, showing the steps on the camera. The use of paper mimicked a whiteboard, and students were welcomed to ask any questions during the session. This technique was originally used to create the lecture videos for the asynchronous course, Quantitative Methods, with the difference that here, this procedure was shown live with the participation of the students.
- 2) From *short oral presentations* to *recorded short presentations*, students were still required to deliver their short presentations on their assigned topics. However, they were asked to record the explanation over their slides, with a duration not longer than three minutes. The files created by each student were then uploaded to Canvas (the e-learning platform for the courses). Thus, all students could watch them and answer related questions in the homework assignments.

¹ Field trips were sponsored by the Field & Fork scholarship at the University of Florida.

² Experiential learning is an engaged learning process whereby students learn by participating in different hands-on activities such as laboratory experiments, internships, practicums, field trips, and study abroad.

- 3) From *final poster presentation* to *final online presentation*, students addressed a contemporary topic from an economic standpoint. There were some differences with the small presentations: (I) the presentation was held live via Zoom during the final week of the semester, (II) the score was established by invited guest professors who acted as the “online audience,” (III) the length of the presentation was twelve minutes with well-defined evaluation criteria, (IV) the audience (including classmates) had three minutes to ask any questions or comments regarding the presentation.
- 4) In order to comply with the stay-at-home regulations, the remaining *field trips* were canceled.

Compared to the beginning of the semester, one additional teaching strategy was adopted during the pandemic:

- 5) *Interactive Excel sessions*: The second half of the semester included Excel applications in two topics of Economics of Resource Use: benefit-cost analysis for environmental projects and valuation methods. During the class Zoom session, the instructor shared his Excel spreadsheet on screen, allowing students to observe how the professor created the template and solved step-by-step each Excel problem. Likewise, students were able to share their spreadsheets with the instructor to address any challenges. At the end of the class day, students were required to submit the final version of their Excel file. This task helped to ensure active learning and constant class participation. In addition, some of these sessions were recorded by request of the students, so they were able to re-watch them later when doing homework assignments.

A summary of the adaptations in the teaching strategies adopted for the two in-person courses is provided in Table 2.

Table 2. Teaching Methodologies Before and After the Pandemic for the Courses Initially Designed to be Taught In Person

Undergraduate Courses Taught In-Person	Before the Pandemic	During the Pandemic
International Policy Trade (Senior level)	<ul style="list-style-type: none"> • In-class questionnaire • Short oral presentation 	<ul style="list-style-type: none"> • Synchronous: In-class questionnaire • Asynchronous: Recorded short presentation
Economics of Resource Use (Junior level)	<ul style="list-style-type: none"> • Final poster presentation • Field trips 	<ul style="list-style-type: none"> • Synchronous: Final online presentation • Synchronous: Interactive Excel sessions

2.3 Methods in the Traditional Online Course

Quantitative Methods (in Food and Resource Economics) is an asynchronous online course divided into different units. Two types of pedagogical methods are used to address the challenges of teaching mathematical principles while using an online setting: active learning (pre-labs, quizzes, and face-to-face reviews) and class personalization (office hours and computer labs). Specifically:

1. *Pre-labs* and *quizzes* are evaluation tools designed to promote active learning. *Pre-labs* are a short task with four to five problems whose solutions can be found in the recorded video lectures of the lesson. *Online quizzes* seek to reinforce the major concepts of the unit and prepare students for the midterms. Answers to quizzes are posted immediately after deadlines. Students also receive *study guides* that

provide them with a summary of the units covered in the modules and help them study for the midterms.

2. *Face-to-face review sessions, office hours, and computer labs* with the professor have become methods to personalize the class. The instructor visits Gainesville every two or three weeks, particularly before midterms, to provide in-person review sessions to students. During the sessions, the instructor (i) solves most of the problems in the *study guide* and also (ii) motivates students to work in groups to solve additional exercises. During the *computer labs*, students bring their laptops to ensure that they have installed the software correctly and can solve the problems presented in the *pre-labs* and the video lectures. The professor usually shows some additional examples and helps them to create their own Excel templates. More information about these online evaluation techniques can be found in Peña-Lévano (2020).

Students also have access to a *discussion board* where they may ask the professor and the Teaching Assistant (TA) any questions in regard to assignments. The instructor also communicates constantly with the student, providing prompt feedback via email and encouraging a personalized environment.

These efforts have been praised by the students in all semesters this class has been offered, with course ratings above 4.64 out of 5.00. Even in the class evaluation of Spring 2020, students provided insights into the instructor's methodology and assistance applied before the pandemic (see *Appendix C* for students' feedback of instructor).

2.4 Modifications to the Online Course

Quantitative Methods required fewer modifications than the two in-person courses (as seen in Table 2). However, a significant challenge in this asynchronous online course was the personalization aspect of the class, as the instructor was not able to travel to Gainesville for the rest of the semester. Thus, although pre-labs, quizzes, and discussion boards continued their format as active learning instruments, the pandemic forced to make modifications to the in-person session components.

Review sessions, office hours, and computer labs were offered as synchronous online Zoom sessions, using a similar methodology described earlier in section 2.2. The professor used the desktop camera to show live, step-by-step, how to solve the problems mimicking the video lectures. For the computer components, the instructor shared his screen displaying an Excel spreadsheet on Zoom and proceeded to solve each problem together with the students. If a student faced any challenge, the Excel file was shared with the instructor using Canvas so that it could be addressed immediately. This interaction helped to preserve student-instructor interaction and provide prompt feedback, which are instruments that encourage students' engagement toward the class material (Allgood, Walstad, and Siegfried 2015; Picault 2019). Table 3 summarizes the teaching methodologies adaptations for the online course.

3 Students' Perceptions and Performance

This section discusses the students' perception of the teaching methodologies used in Spring 2020 and their opinion regarding their modifications during the second half of the semester after returning from their Spring break. The surveys were conducted in April 2020, at the end of the Spring semester, in which they were asked to compare their learning before and during the lockdown.

Table 3. Teaching Methodologies for Each Course Type Before and After the Pandemic for the Course Originally Designed to Be Taught Online

Undergraduate Courses Taught In-Person	Before the Pandemic	During the Pandemic
Quantitative Methods (Junior level)	<ul style="list-style-type: none"> • Asynchronous activities: pre-labs, quizzes, and discussion boards • In-person activities: review sessions, office hours, and computer labs 	<ul style="list-style-type: none"> • Asynchronous activities (no change): pre-labs, quizzes, and discussion boards • Synchronous activities: review sessions, office hours, and computer labs

3.1 From Traditional In-Person to Synchronous Online Courses

Students taking Economics of Resource Use and International Policy Trade in Agriculture were asked in an anonymous survey their perception on the learning retention³ of the class material (in percent of content learned) before and during the pandemic. All thirteen students⁴ were located at Plant City, with most of them working full-time or part-time, starting their junior or senior years, and with ages ranging from nineteen to thirty-one years old. In order to help students with their work schedule, the courses were offered in a three-hour class on a specific day of the week, so students only needed to take one day off in order to attend the lectures. This class arrangement was preserved for the entire Spring 2020. All thirteen students in both courses responded to this survey (100 percent response rate). Their response is depicted in the two histograms of Figure 1. Before the pandemic, 77 percent of students stated that they were learning at least 50 percent of the class material. During the lockdown period, 70 percent of them expressed that they still were learning at least 50 percent of the content; however, the distribution became more centered, with fewer students being confident that they had mastered the lectures. This provides suggestive evidence that the modification to teaching methodologies helped to keep students learning the material.⁵ However, because of the small sample size, the results should be interpreted with caution.

Students in Plant City reported that they did not have to relocate from their residences. For this reason, relocation was not accounted as a stressor factor at this location. However, many of the students have families (spouse, parents, and/or children). Thus, about half of them expressed that it was challenging to find a balance between spending time studying and taking care of their family members (as depicted in Figure 2). Interestingly, responses from the survey show that not being able to meet with classmates to study and/or collaborate while doing homework was the most important factor that added stress. Allgood, Walstad, and Siegfried’s (2015) article suggests that students’ engagement on the class material may be improved by interaction and connection with peers, which is more difficult to achieve by working together remotely. This may be particularly true for students in Plant City, as they take most of their core courses together and in small groups, allowing them to know each other better and work on their tasks in teams.

Plant City students choose this location in order to have a personalized teaching experience and a college degree from the University of Florida, without the need to move to the main campus (Gainesville). The in-person courses in small classrooms are also one of the attractive features of the Agribusiness major for students that seek a non-online college degree. Thus, it is not surprising that students

³ Learning retention is the process of acquiring and storing information in the long-term memory.

⁴ Seven students in Economics of Resource Use course and six students in International Policy Trade in Agriculture.

⁵ Despite counting with the participation of all thirteen students, given the small sample size, testing whether these proportions are statistically different would not provide an overall insight for larger classes.

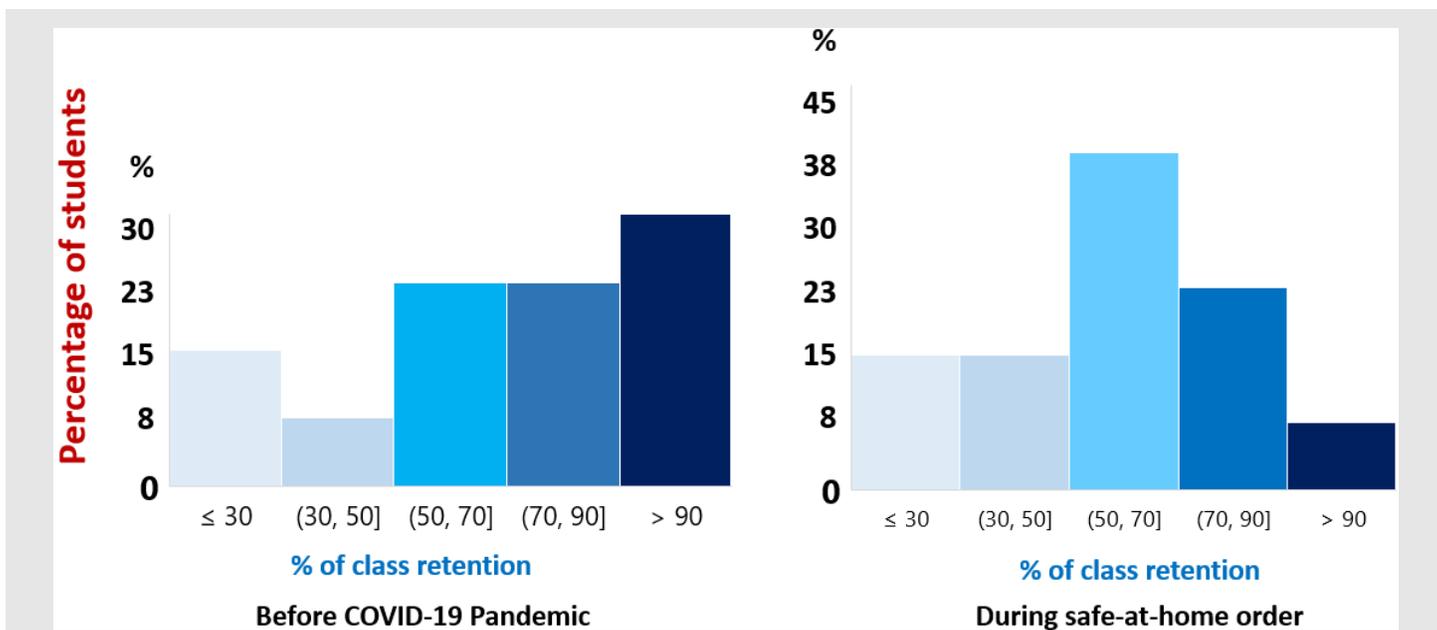


Figure 1. Students' Opinion about Learning Retention—in Percent of Material Students Perceived They Learned Successfully—Before and During Lockdown for Synchronous Classes

emphasized that working only online was also an important stressor during the pandemic. Finally, considering that most students have part-time or full-time jobs in Plant City, it is not unexpected that about 70 percent of the surveyed students considered working-related matters during the pandemic were a factor challenging class performance.

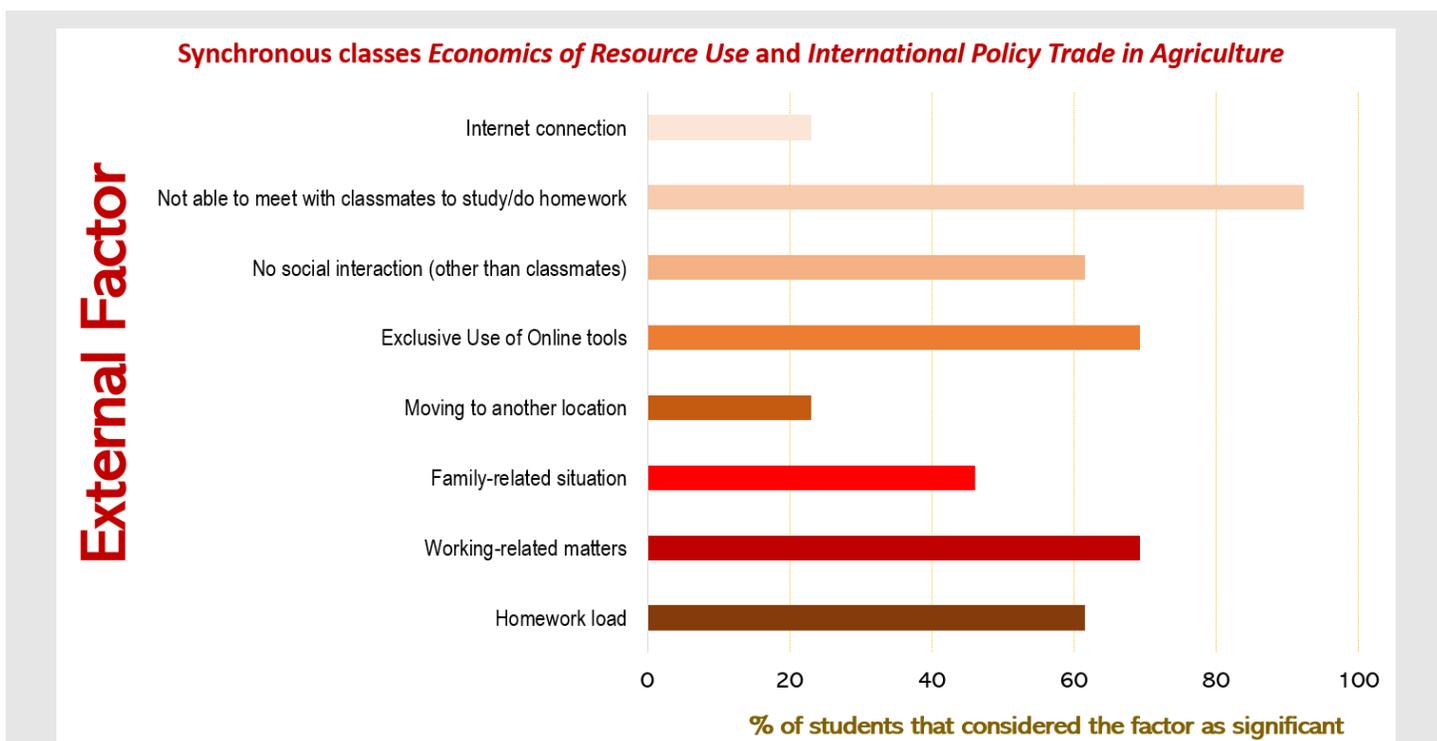


Figure 2. Students' Perceptions of External Factors that May Have Affected their Performance in the Synchronous Courses

In an effort to help students to reduce the stress during the pandemic, the instructor attempted to keep constant communication with the students, providing prompt feedback on their tasks. Their perceptions regarding these interaction methods are graphically summarized in Figure 3. Interestingly, recording the *interactive Excel sessions* (the new teaching methods adopted during the pandemic) was an important tool supporting student-teacher interaction. Figure 3 shows that about 92 percent of the students responded that the professor’s prompt feedback on assignments and oral presentations, as well as the synchronous online sessions, were key methodologies that helped them to mitigate the stress induced by the pandemic. As stated by Kuh et al. (2006), student engagement is improved by an active interaction between a professor and students, which may act as an essential contributor to academic performance. (See *Appendix A* for students’ qualitative feedback in the two courses.)

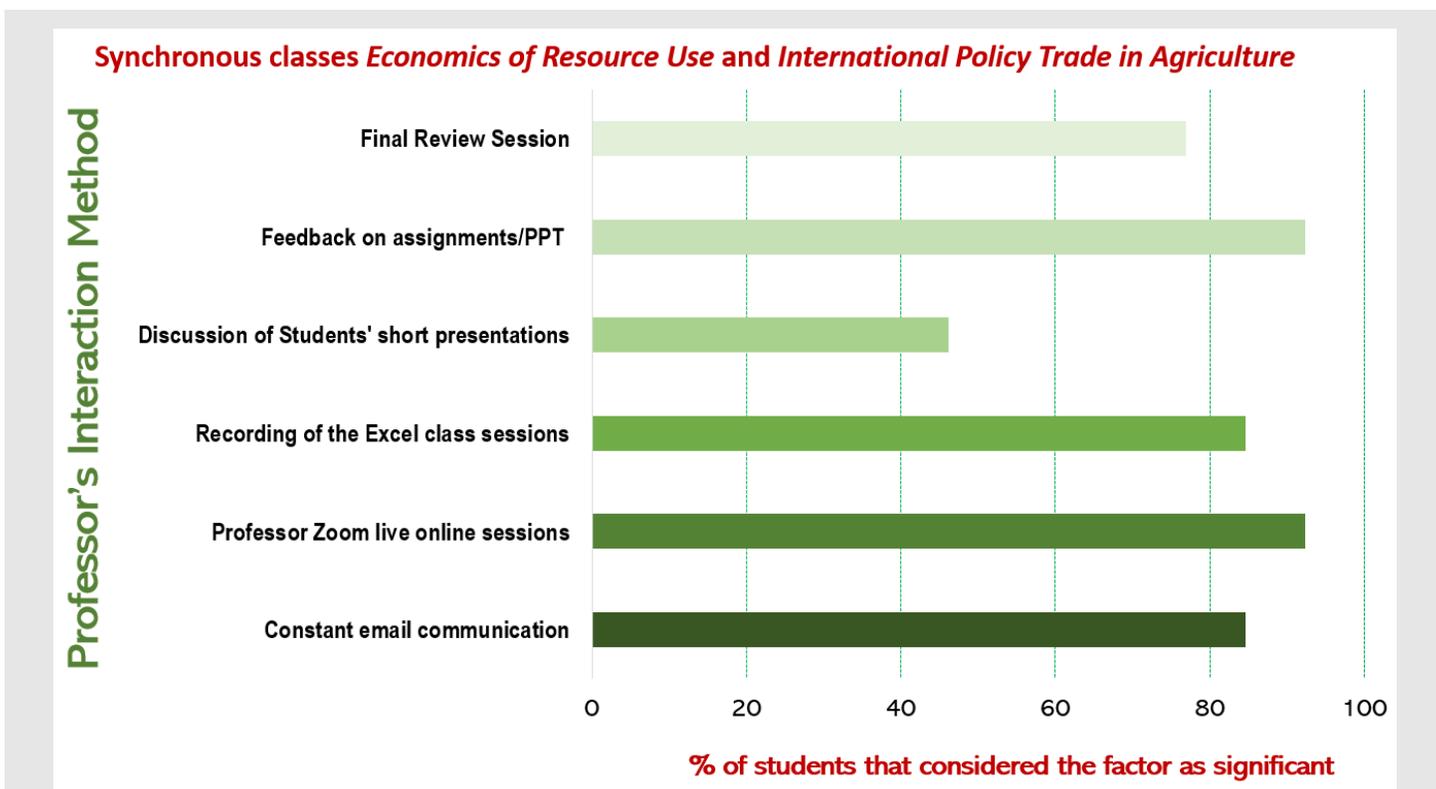


Figure 3. Students’ Perceptions of the Professor’s Interaction Method that May Have Helped to Mitigate the Stress on Class Performance During the Pandemic

3.2 Adapting the Online Course

During the pandemic, the structure of Quantitative Methods did not change drastically compared to the traditional classes. However, almost all 34 students taking this course were originally in Gainesville or at a nearby location. Most of them were full-time students who lived on campus or in apartments, pursuing a four-year college degree in Agribusiness or a related major. Ergo, many of them needed to relocate when COVID-19 became an impending concern. Not surprisingly, more than 50 percent of the class expressed that moving to another location added substantial stress and affected their academic performance (shown in Figure 4). Interestingly, the major stressing factor perceived by the students was not being able to meet with classmates to study or do homework together, similar to the case of the synchronous courses in Plant City. An attribute that calls attention is that more than half of students also emphasized that having to depend exclusively on online tools was a stress contributor, which shows the importance of the absence of in-person sessions/interactions with the professor.

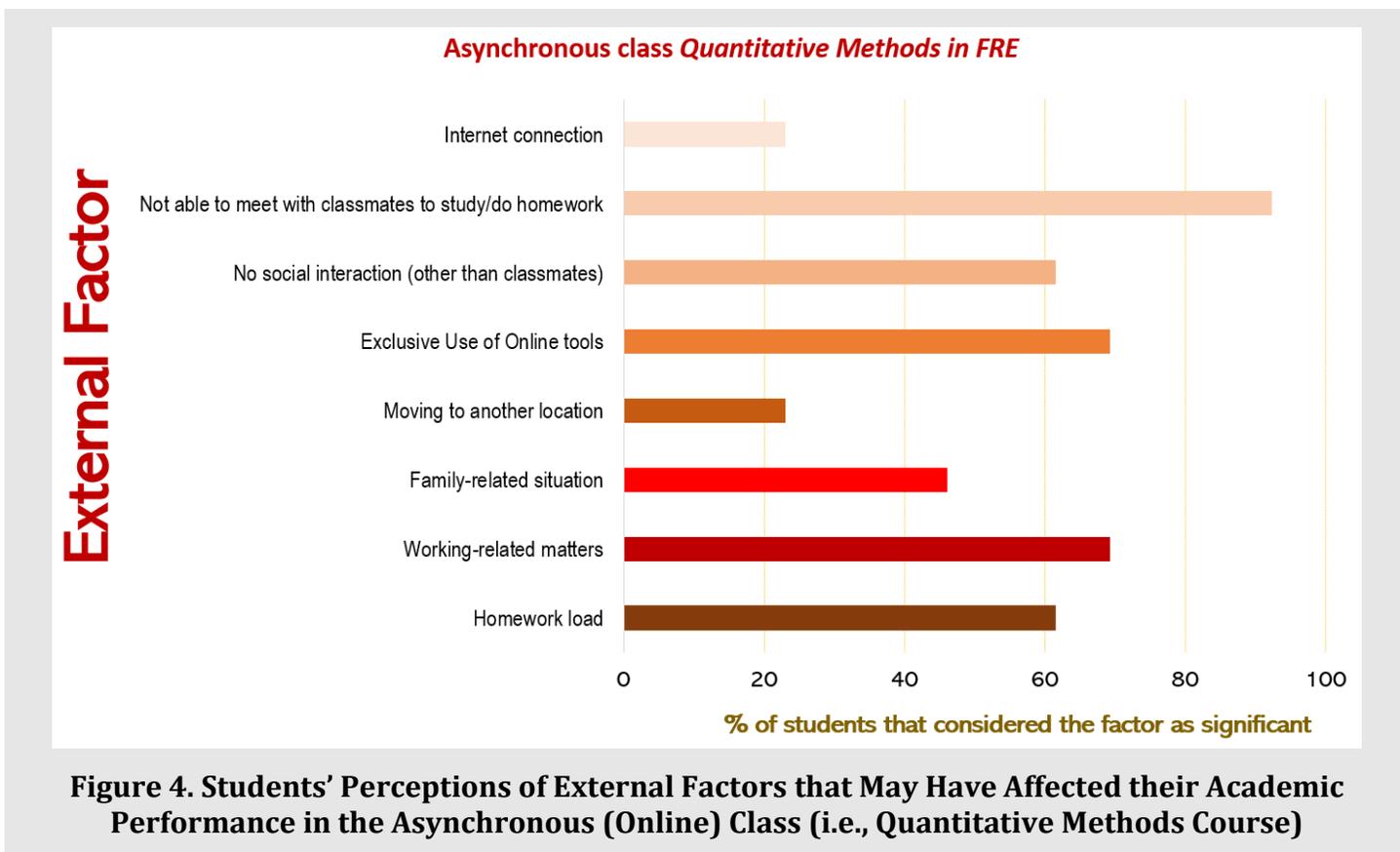


Figure 4. Students’ Perceptions of External Factors that May Have Affected their Academic Performance in the Asynchronous (Online) Class (i.e., Quantitative Methods Course)

Perceptions regarding their learning of the class material changed drastically during the pandemic (displayed in Figure 5). This was supported by a paired z test (p -value < .05) that compared the perception of each student regarding class retention prior to the pandemic and during the stay-at-home order. About 82 percent of the students responded that they were learning at least 70 percent of the material prior to the mandate. In contrast, only 20 percent of students expressed that they were learning that percentage of the material during the quarantine period.

This change in perception can be attributed to several factors: (i) students moving from the main campus to a different location with limited internet access may have difficulties accessing the course videos or the online help sessions, (ii) the relocation to distant locations made students delay their coursework in many classes simultaneously for several days or even weeks, and (iii) the impending stress of the pandemic affected the concentration and mental health of several students, especially those who were taking care of their family and relatives (as expressed in Figure 4).

The interaction between students and the instructor was also important for many students, in particular the constant email communication (Figure 6). Likewise, more than half of the class (eighteen out of thirty-four students) participated in the online computer labs, of which fifteen of them said they found these sessions helpful. Students also found crucial the role of the TA for this course. Eighty-nine percent of students that participated in the Excel sessions expressed that the assistance and help from the TA were above average during the pandemic. The result of these efforts was reflected in the positive evaluation comments, praising both the instructor and the TA (see *Appendix A*).

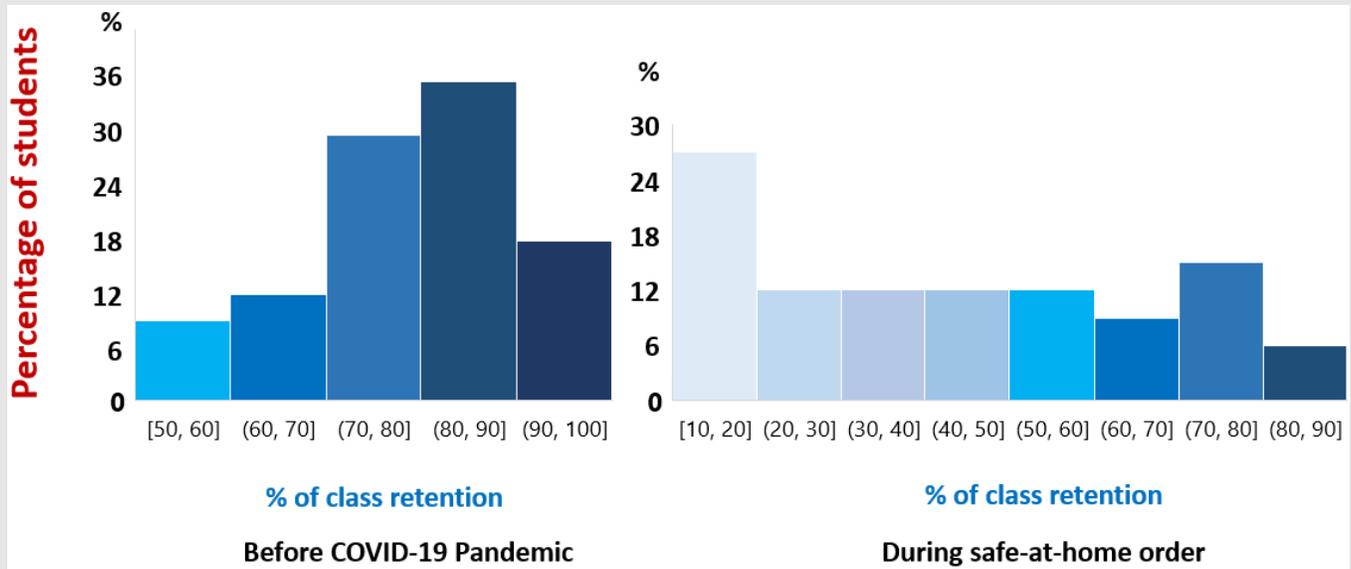


Figure 5. Students' Opinion About Class Material Retention (in Percent) Before and During Lockdown for the Asynchronous (Online) Course (i.e., Quantitative Methods Course)

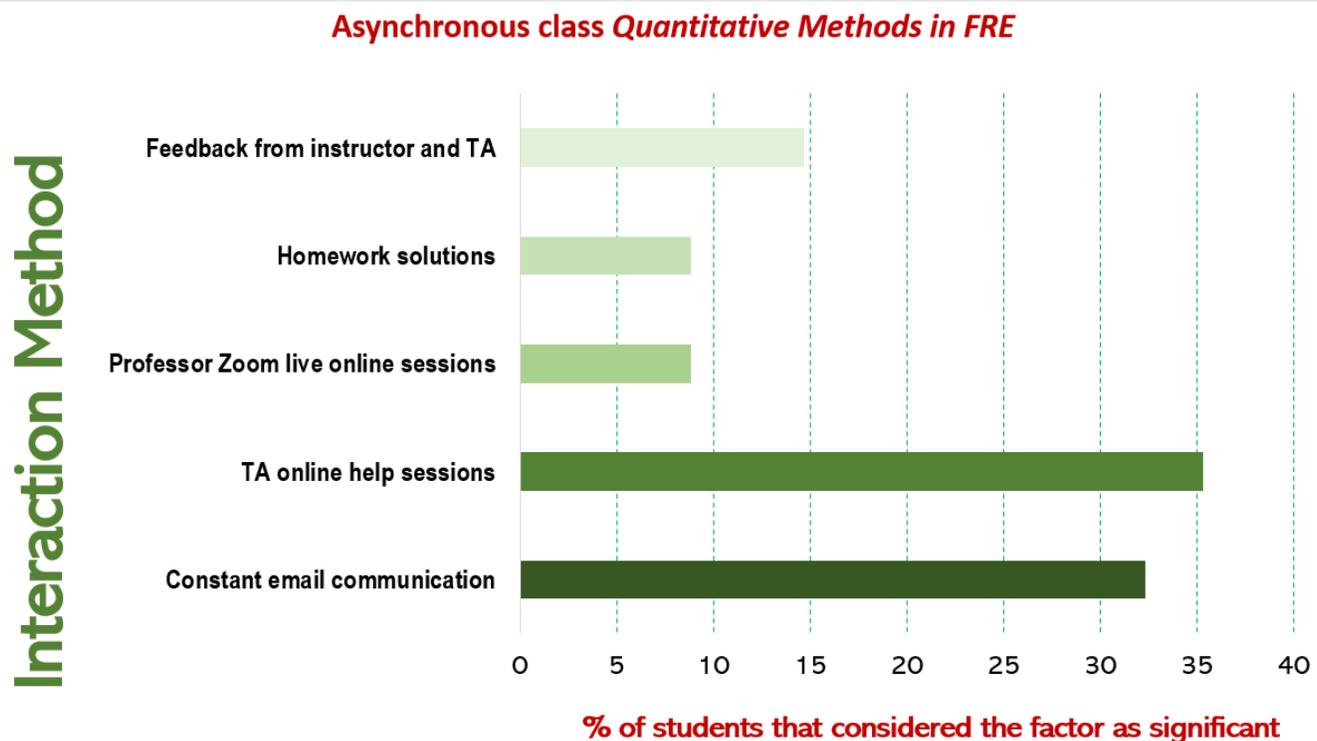


Figure 6. Students' Perceptions of the Professor and TA's Interaction Method that May Have Helped to Mitigate the Stress on Class Performance During the Pandemic

3.3 Students' Performance

A paired comparison test was used to contrast the academic performance of students prior to and during the pandemic for each course. Particularly, quizzes and homework assignments were compared for each course. The average score of each activity before and during the pandemic was evaluated to determine

whether the adaptation of the teaching methods could have affected students’ performance. Table 4 shows the summary statistics of the paired samples, whereas Table 5 shows the statistical analysis of these pairs. For Economics of Resource Use, students scored overall a lower grade (-1.84 points) in quizzes but received a higher score (+2.93 points) in their homework assignments. This may suggest that students benefited from the *interactive Excel online sessions*, which were crucial components in the homework.⁶ This is particularly true for the students that were in the Agricultural Communication and Education major, for whom this software was a new tool.

Table 4. Summary Statistics of the Paired Samples

Course	Task	Pandemic Timing	Mean	N	Standard Deviation
<i>Pre-pandemic in-person course</i>					
Economics of Resource Use	Quiz	Prior	21.89	7	2.19
	(Base = 25 points)	During	20.04	7	2.34
	Homework	Prior	46.21	7	3.56
	(Base = 50 points)	During	49.14	7	2.53
International Agricultural Trade	Quiz	Prior	8.73	6	8.73
	(Base = 10 points)	During	8.41	6	8.42
	Homework	Prior	31.57	6	2.33
	(Base = 35 points)	During	29.25	6	4.72
<i>Pre-pandemic online course</i>					
Quantitative Methods	Quiz	Prior	8.29	34	1.30
	(Base = 10 points)	During	8.82	34	1.56
	Homework*	Prior	85.25	34	12.48
	(Base = 100 points)	During	78.21	34	28.88

Note: Quizzes for these courses are based on 25 points.

*For comparison between homework assignments, they are expressed based on 100 points.

In contrast, scores were not statically significant at the 5 percent level for students taking International Trade Policy and Quantitative Methods. This suggests that, despite the drastic changes in teaching methodology and not being able to work with classmates, students were able to keep a similar quality in their academic performance. Interestingly, when looking at Figures 1 and 5 that show students’ perception, students seemed afraid that the pandemic might have a negative impact on their learning. However, Tables 4 and 5 show that this was not reflected in their grades. In fact, many of them were able to increase their score in both synchronous and asynchronous courses.

Students expressed that this improvement in scores was also in part to the ability of the instructor to change the structure quickly while keeping constant communication with them while understanding students’ specific circumstances. This is supported by correlational evidence based on students’ comments on the course (see *Appendix A*).

⁶ Quizzes for this course did not include Excel problems as they are short tasks.

Table 5. Results of the Paired Sample Test

Course	Pair (Before–During)	Mean	N	Standard Error	Z-Test ^a	Degrees of Freedom	p-value (two-tailed)
Economics of Resource Use	Quiz	1.84	7	0.49	3.77	6	< .01
	Homework	-2.93	7	0.60	-4.86	6	< .01
International Agricultural Trade	Quiz	0.31	6	0.28	1.92	5	.31
	Homework	2.33	6	1.21	1.12	5	.11
Quantitative Methods	Quiz	-0.53	34	0.26	-1.96	33	.06
	Homework	7.05	34	3.46	4.03	33	.09

^a Z test is used for this evaluation as the study counts with the entire population of students’ scores.

4 Conclusion and Final Remarks

The COVID-19 pandemic led to unexpected changes to the social and educational aspects of college students’ lives. Instructors needed to make structural shifts in the delivery of the courses in a short period of time. Common challenges regarding teaching online during 2020 were related to (1) successfully delivering the material of the courses given the time constraint, (2) lack of experience in teaching online and implementing different teaching tools, (3) how to keep students motivated in the courses during the pandemic, and (4) how to minimize difficulties with technology and software used in the courses.

To investigate how instructors and students coped with these challenges, we evaluated the case of three agribusiness undergraduate-level courses during Spring 2020. These courses were International Trade Policy in Agriculture and Environmental of Resource Use—both typically taught in-person in Plant City, and Quantitative Methods in Food and Resource Economics—delivered asynchronously in Gainesville with in-person sessions. Regardless of the initial delivery method, the three courses shared similar class methodologies during the stay-at-home period. Synchronous review sessions, prompt feedback of graded assignments, and constant communication with the students were key methods to help students face the transition of instruction during the Spring semester. Students from both locations responded positively to these efforts. Nevertheless, both groups of students expressed that not being able to work with their classmates was a major factor of stress affecting their learning.

This article provides three insights into the development of virtual courses and delivery of online instruction of courses that heavily rely on mathematical components and software applications.

- 1) Synchronous demonstration of problems using the software assigned in class (such as Microsoft Excel) helps students to understand how to work with spreadsheets and other analytical tools needed for their assignments. In particular, it is important to remember that students have heterogenous experience and skills with computer software. For this reason, it is suggested to record these sessions so students can review them later at their own time and pace. This practice should continue in the post-pandemic world as students are diverse in terms of their attention capacity, learning style, and technical skills. One caveat is that providing them with recorded lectures would reduce attention span and attendance rate to the live sessions. One approach to address this issue is sharing recorded lectures only to students who request them for valid reasons (e.g., absence due to illness).
- 2) Students did not seem optimistic regarding their performance during the sudden change in their academic courses. However, they reported that an appropriate methodology and constant communications help them to alleviate the stress induced by the pandemic.

- 3) For asynchronous classes, monthly or biweekly live office hours may help students to engage in the course material because the one-to-one interaction with the instructor may allow them to solve any specific question on the content or express their concerns.

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