

Impacts of COVID-19 on Transportation Engineering Education and Research

Center for Transportation, Environment, and Community Health

Final Report



by

Ruey Long Cheu
Rodolfo Rincones
Emiliano Ruiz
Ana Sofia Simental Unzueta

The University of Texas at El Paso

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16. Abstract In March 2020, the COVID-19 pandemic began to spread in the United States forcing many universities to discourage in-person classes and research meetings. Many faculty members modified their modes of instruction and research activities. This research surveyed transportation faculty members across the United States that focused on the changes in their teaching and research practices, and the supports that were provided by the universities to address such difficulties. The survey was conducted between May 14 to June 12, 2020 via the Internet and collected responses from 92 transportation faculty members. The majority of the respondents rated their universities of being “supportive” to “very supportive” in online teaching and learning, and continuously “supportive” in research as before the COVID-19. Eighty-three percent of the respondents who taught undergraduate transportation courses switched from in-person lectures to online lectures. Majority of the respondents replied on technology to offer problem solving sessions, office hours, tests and examinations. However, only 22% of the faculty members taught online laboratory sessions. Majority of the faculty members faced restrictions on travel, field work and laboratory experiment that affected their research projects. Although the opinions on the outlook to secure new research projects was mixed, majority of the faculty members did not expect a significant change in their research performance. The faculty members reported, on average, an increase of 4.4 hours/week of time spent on teaching. This increase was partially offset by an average reduction of 2.5 hours/week in research and service. The end result was an average net increase of 1.9 hours/week of working time during COVID-19.			
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EXECUTIVE SUMMARY

The COVID-19 pandemic has forced many universities in the United States to change most of the in-person activities to online interactions. Many faculty members switched from face-to-face instructions to teaching from home, or hybrid mode of in-classroom and remote teaching. Researchers continued to perform some, if not all of the research tasks remotely.

An online survey had been conducted on transportation faculty members in the United States to understand the changes in teaching activities, research challenges, university supports and workload caused by the COVID-19 pandemic in the spring semester or quarter, from March to June 2020. Ninety-two faculty members responded to this survey.

Outputs.

The major findings of the survey were:

- University support: Majority of the respondents stated that their universities were “supportive” to “very supportive” in making policy changes and providing resources for faculty members and students to meet the challenges in online teaching and learning. Majority of the respondents stated that their universities were “supportive” in conducting certain research activities remotely.
- Teaching: Eighty-three percent (83%) of the faculty members switched from in-person to online lectures for transportation related undergraduate courses. Most of the faculty members relied on information technology to conduct problem solving sessions, office hours and examinations. However, only 22% of the faculty members taught online laboratory sessions.
- Research: The COVID-19 had prohibited faculty researchers from performing field work, laboratory experiments, travel to meeting and conferences. However, majority of them did not expect a significant change in their research performance. The respondents have mixed outlook in the funding situation, ability to secure and deliver future projects.
- Faculty workload: The faculty members, on average, worked an extra 1.9 hours per week during COVID-19. Compared to the pre-COVID-19 period, they spent additional 4.4 hours per week in teaching but reduced research and service time by 2.5 hours per week.

Outcome.

The survey findings may potentially influence stakeholders in the following ways:

- University administrators: The survey findings inform university administrators the challenges faculty members and students faced, and how other universities coped with COVID-19.
- Faculty members: The survey findings enabled faculty members to share their collective teaching and research experiences with peers.
- Students: The survey findings provided feedback on how faculty perceived the ways students coped with the new learning environment.
- Research funding agencies: This report documented the research challenges faced by faculty researchers to the funding agencies.

Impacts.

Although preliminary, the outcomes of the survey are likely to lead to the following impacts:

- University administrators: The survey findings may lead to university administrators to adjust policies in support of teaching and learning.
- Faculty members: The survey findings enabled faculty members to improve their teaching methodologies and better manage research projects during COVID-19.
- Students: The students may benefit from the policy changes, resources provided by the universities directly to them and indirectly through the faculty members. The improved learning environment will continue to train high quality transportation engineers for the workforce.
- Funding agencies: The funding agencies may consider the challenges faced by faculty researchers in the upcoming calls for proposals and make adjustment to project evaluation criteria.

The impacts are not limited to the current COVID-19 episode but will also influence the responses to future pandemics.

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1 INTRODUCTION

1.1 Background

In December 2019, an infectious disease now known as the Coronavirus Disease 2019 (COVID-19) emerged in Wuhan, China and began to spread through direct contact between people and indirect contact with contaminated objects and/or surfaces. By January 20, 2020 when the World Health Organization (WHO) declared this disease a Public Health Emergency of International Concern (PHEIC), 7,818 known cases had been confirmed, including 82 cases outside of China (WHO, 2020b). The United States found the first COVID-19 case two days later on January 22, 2020 (CDC, 2020b). The COVID-19 was declared a national emergency on March 13, 2020 by the President of the United States (Federal Register, 2020). By this day the number of cases in the country had increased to 3,487. By September, 2020, more than 6.9 million people in the United States had contracted the virus, and as a consequence more than 200,000 deaths were reported (CDC, 2020a).

In response to the initial guidelines issued by the Center for Disease Control and Prevention (CDC) on March 18, 2020 (CDC, 2020d), many universities across the United States implemented action plans that were arranged in stages or phases. To comply with the CDC guidelines, social distancing on campus was encouraged and remote instruction by faculty members was highly recommended. Since the outbreak coincided with the spring break, many universities extended the break from one to two weeks to give instructors time to implement the new teaching plans, and to let students stayed home as the “quarantine period”. After the extended spring break, teaching activities were resumed, with most courses taught in online format and a few courses in hybrid format (combination of online and in-person teaching activities compliant with social distancing). Faculty members and staff were required to work remotely from home and only came to the campus when it was utterly necessary. Instructional activities such as lectures and problem-solving sessions had little difficulty when changing to online format. However, for laboratory sessions, the option of remote instruction was challenging. Most universities also restricted their faculty members, staff and students from participating in official activities outside of their campuses. This meant that researchers could not travel to conferences, attend project meetings, perform field work and etc. These policies created difficulties for some faculty members to perform their usual teaching and research duties.

During this challenging period for faculty members and students, many research questions emerged. Among the questions were:

- What teaching activities were impacted by COVID-19? How did faculty members modify teaching activities in response to such impacts?
- What research activities were impacted by COVID-19? How did faculty members modify research activities in response to such impacts? What was the new outlook of research programs?
- How did universities support faculty members to work from home? What resources were provided to faculty members to cope with the changes in teaching and research activities?

These questions were not only of concern to the faculty members, staff and students, but also of interest to the university administrators, parents and research funding entities. A survey was therefore conducted to collect data from faculty members to answer these questions.

1.2 Objective and Scope

The objective of this research was to survey transportation engineering faculty members in the United States on the changes in teaching and research practices, and the supports they received from the universities during COVID-19. The authors were interested in collecting, analyzing and sharing the experiences and challenges faced by the faculty members in the transportation engineering discipline. The education and research challenges addressed in this article also complement the recent discussions made by Hendrickson and Rilett (2020) on the impacts of COVID-19 on transportation engineering.

This research focused on answering the above research questions. The survey subjects were limited to transportation engineering faculty members in the United States because the authors were familiar with the teaching and research activities in this discipline. The time period covered by the survey was from March to June, 2020, when universities started to implement COVID-19 response plans until the end of the spring semester/quarter. This effort was the authors' first step in investigating the impacts of COVID-19 in transportation engineering education and research. Surveys that cover different groups of stakeholders (e.g., students) and time period (e.g., Fall 2020 semester/quarter) will be addressed in follow-up research.

1.3 Outline of Report

This report is organized as follows. After this Introduction, COVID-19, initial responses of universities and past experiences on online teaching of civil engineering courses are reviewed. The next section, Transportation Faculty Survey, presents the survey instrument and its implementation. The Results and Discussions section summarizes the survey findings, discusses their implications before making the Conclusions.

2 REVIEW OF EVENTS AND LITERATURE

2.1 The Coronavirus Disease of 2019

The Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) (WHO, 2020a). The source of the COVID-19 virus is yet to be fully determined. It is widely believed to have come from an animal reservoir before crossing over to human (CDC, 2020e). Human-to-human transmission of the COVID-19 virus is known to take place via respiratory droplets (CDC, 2020c). Wearing face covers (masks) and maintaining a social distance of at least 6 ft (2 m) are effective ways in reducing transmission (CDC, 2020c).

When a person is infected with COVID-19, he/she becomes an asymptomatic carrier or simply a carrier. A carrier does not exhibit any symptom (such as fever, shortness of breath, muscle or body aches, nausea or vomiting) but is capable of unknowingly transmitting the COVID-19 virus to other persons. After an incubation period of up to 14 days, an asymptomatic carrier may turn into a symptomatic spreader, or a spreader. A spreader has a higher risk of transmitting the virus to another person. Other than the initial symptoms of fever, shortness of breath, muscle or body aches, nausea or vomiting, a spreader may later experience breathing difficulties and chest pains that lead to a fatal outcome (CDC, 2020f). Because the incubation period of the COVID-19 is up to 14 days, a person who does not show any symptom for 14 continuous days is very unlikely to be a carrier.

Vaccine for COVID-19 is yet to be available. At present, the most effective way of slowing down the spread of COVID-19 in a community is to identify the carriers and spreaders by testing, followed by isolating them in medical treatment facilities. The COVID-19 test involves obtaining a sample from an individual's respiratory system and send it to a laboratory for analysis. The positive or negative test result may be obtained from several hours to several days (CDC, 2020g). Many communities do not have the resource to test every person who wants to be tested. Therefore, the limited tests are administered to mostly suspected spreaders, healthcare professionals and segments of population that have higher risk of being infected. If a person is suspicious of being a carrier but is not able to be tested, he/she must be isolated at home (quarantined) for 14 days.

The above discussions have summarized the characteristics of COVID-19, the ways to contain its transmission and the major challenges faced by the communities. The following section reviews and discusses how universities proactively responded to the risk of COVID-19 on campuses while continuing with teaching and research activities.

2.2 Responses by Universities

Universities campuses, like schools, have classrooms where students and faculty interact in close proximity. These are the places with high potential for the human-to-human transmission of COVID-19. The University of Washington was the first university to cancel in-person classroom instruction on March 6, 2020 (Thomason, 2020). Other universities started to implement similar policy. In addition, they encouraged social distancing. Many universities

extended the mid-March spring breaks from one to two weeks. When classes resumed after the break, almost all of them were converted to online or hybrid (a combination of in-person and online) delivery. Faculty members, staff and students were asked to study or work from home unless their presence on campuses was essential. Many universities also mandated everyone on campus to wear masks and observe social distance. The Spring 2020 semester/quarter final examinations were mostly given online. Commencement ceremonies were postponed or changed to online format. [Table 1](#) summarizes the COVID-19 responses at four universities, which are the partners in the Center for Transportation, Environment and Community Health (CTECH), from March 2020 up to the end of the Spring 2020 semester/quarter. These four universities are located in California, Florida, New York and Texas, the states that had the largest number of COVID-19 infections at that time.

2.3 Online Teaching and Learning of Civil Engineering Courses

In the United States, there are 359 civil engineering degree programs that are accredited by the Accreditation Board for Engineering and Technology (ABET). None of these programs is 100% online (ABET, 2010). This is mainly because many civil engineering concepts are best taught and learnt in in-person classes and in hands-on experiments. Very few studies have compared civil engineering courses that were taught online and in-person.

A study that examined the impact of online teaching and learning of a fluid mechanics course in the civil engineering discipline was performed by Niessenson et al. (2017). In each of the three academic quarters, a section of the course was taught in hybrid mode (pre-recorded video lectures, combined with in-person problem solving sessions) while another section of the same course was taught by the same instructor in face-to-face mode (in-person lectures and in-person homework solving sessions). Niessenson et al. found that, for the three consecutive quarters, higher percentages of students who took the course in the hybrid sections earned C and better grades. They also had better learning experiences. The findings suggested that if a hybrid course is delivered in the correct way, the students may have better learning outcome.

In March 2020, while universities were formulating and implementing the COVID-19 emergency response plans, Sahu (2020) submitted an article that discussed issues concerning large scale implementation of online teaching and learning. These issues included student access to computer and the Internet, instructor's familiarity with the online teaching tools, challenges in online assessments and etc. Sahu also discussed the potential mental health issues that students and faculty and suggested several action plans to the university decision makers. Among the suggestions were (i) having clear policies that were communicated effectively to the campus community; (ii) giving faculty members flexibility of adapting the courses to online delivery; (iii) mobilizing supporting units (such as Information Technology (IT) unit, housing and food services, international office, student wellness) to support the transition from traditional to online teaching/learning.

Bozkurt et al. (2020) advocated that online or hybrid delivery of courses is more than just adopting IT tools to disseminate course materials and information. Instead, instructors should focus on student needs, including the availability and accessibility of the learning tools.

Table 1 Initial responses at selected universities

Date	Day	Univ. of California at Davis, CA	University of South Florida, Tampa, FL	Cornell University, Ithaca, NY	The Univ of Texas at El Paso, TX
3/4	W	-	Suspended all international travel	-	-
3/7	Sa	Encouraged online teaching	-	-	-
3/11	W		Encouraged online teaching	Encouraged social distancing	-
3/12	Th	Prohibited in-person examination	-	-	Suspended all international travel
3/13	F	-	-	Suspended all classes for 3 weeks	Imposed social distancing
3/14	Sa	-	Began spring break	Sent students home	Began spring break
3/20	F	End of Winter 2019 Quarter	-	-	-
3/21	Sa	Began spring break	-	-	-
3/22	Su	-	End of Spring break	-	End of spring break
3/23	M	-	Began 2 weeks of transition to online classes.	-	Issued stay-home order
3/27	F	-	Issued stay-home order	-	-
3/28	Sa	-	-	Began spring break	-
3/29	Su	End of spring break	-	-	-
3/30	M	Began Spring 2020 quarter with most classes online	-	-	Resumed classes: online only
4/5	Su	-	-	End of spring break	-
4/6	M	-	-	Resumed classes: online only	-
5/7	Th	-	Last day of class. Canceled in-person commencement	-	-
5/15	F	-	-	-	End of Spring 2020 semester
5/16	Sa	-	-	-	Postponed commencement
5/23	Sa	-	-	End of Spring Semester	-
5/24	Su	-	-	Postponed commencement	-
6/12	F	End of Spring 2020 quarter. Canceled in-person commencement	-	-	-

3 TRANSPORTATION FACULTY SURVEY

3.1 Survey Instrument

The survey instrument consisted of 38 questions organized into four sections: Sections A, B, C and D. Section A focused on the supports provided by universities to help faculty members to transition from the traditional operating mode to follow the COVID-19 response plan. Section B consisted of questions about the faculty members' experiences in teaching undergraduate transportation related courses during COVID-19. Section C compared the respondent's research activities before and during COVID-19. Section D asked the respondents for their demographic profiles, teaching and research workloads and university statistics. Table 2 summarizes the 38 questions.

The 38 survey questions and answers were presented to respondents in five different formats (see the rightmost column in Table 2):

- Multiple choice – 1. These were typical multiple-choice questions. Each question required a respondent to select only one answer.
- Multiple choice – many. These were typical multiple-choice questions. In each question, a respondent was expected to select one or more answers.
- Multi-point scale. Each question consisted of several points (statements) arranged in rows. Each point has a scale (choices arranged in different columns). A respondent was expected to select a choice for each statement.
- Matrix. The matrix style presents two “multi-point scale” questions side-by-side, with the same points and scales to solicit the answers before and during COVID-19.
- Text slider. This type of questions is similar to “multiple choice – 1, except that each question required a respondent to slide a button along a horizontal bar to the his/her answer.

At the end of each section, a “comment box” is provided for the respondent to type his/her comment.

These questions were entered into QuestionPro (2020) online survey tool. Five civil engineering and/or transportation faculty members tested the draft questions and provided feedbacks. The revised survey instrument was approved by The University of Texas at El Paso (UTEP) Institution Review Board (IRB). The survey instrument is included as the Appendix of this report.

Table 2 Summary of survey questions

No.	Nature of Question	Type of question
A1	Resources to support teaching before and during COVID-19	Matrix
A2	Resources to support learning before and during COVID-19	Matrix
A3	Resources to support research before and during COVID-19	Matrix
A4	Additional comments	Comment box
B1	Course contents	Multiple choice - 1
B2	Class size	Multiple choice - 1
B3	No. of teaching assistants	Multiple choice - 1
B4	No. Of times taught in the past	Multiple choice - 1
B5	Changes in teaching practice during COVID-19	Multiple choice - many
B6	Modes of teaching before and during COVID-19	Matrix
B7	Use of IT in teaching before and during COVID-19	Matrix
B8	Duties of teaching assistant before and during COVID-19	Matrix
B9	Concerns for students	Multi - point scale
B10	Additional comments	Comment box
C1	Impact of COVID-19 on research activities	Multi - point scale
C2	Impact of COVID-19 on resources for research	Multi - point scale
C3	Strategies to overcome challenges	Multi - point scale
C4	Impact of COVID -9 on research performance	Multi - point scale
C5	Additional comments	Comment box
D1	Age	Multiple choice - 1
D2	Gender	Multiple choice - 1
D3	Race/ethnicity	Multiple choice - 1
D4	Age groups of household members	Multi-point scale
D5	Faculty rank	Multiple choice - 1
D6	No. of years of faculty experience	Multiple choice - 1
D7	Institution's enrollment	Multiple choice - 1
D8	Minority institution status	Multiple choice - 1
D9	No. of graduate/PhD courses taught in Spring 2020 semester	Multi-point scale
D10	No. of research students supervised in Spring 2020 semester	Multi-point scale
D11	No. of hours worked/week before COVID-19	Multiple choice - 1
D12	No. of hours worked/week during COVID-19	Multiple choice - 1
D13	% time for teaching, research, service before COVID-19	Text slider
D14	% time for teaching, research, service during COVID-19	Text slider

3.2 Survey Implementation

This survey was designed for transportation faculty members in the ABET-accredited civil engineering undergraduate programs in the United States. This was because:

- ABET provided to the public a list of accredited civil engineering undergraduate programs in the United States (ABET, 2020) from which the subjects were recruited;
- Meeting the ABET accreditation requirement meant that the faculty members must meet certain level of teaching quality and achieve the desired learning outcome; and
- The focus on transportation engineering made the teaching and research topics which are within the scope of CTECH.

After downloading the list of 395 ABET-accredited civil engineering undergraduate programs, a recruitment list was compiled by searching the official university websites to identify faculty members who were (i) teaching at least a transportation related course or (2) leading/participating in at least a transportation research project in the Spring 2020 semester/quarter. Email addresses of 855 faculty members were compiled into a recruitment list.

Initial email invitations were sent to the 855 faculty members in the recruitment list on May 14, 2020. Reminders were sent by email to all the faculty members in the recruitment list on May 24, 2020 and June 3, 2020, until the survey was closed on June 12, 2020.

4 RESULTS AND DISCUSSIONS

4.1 Profile of Respondents

Eight hundred fifty-five transportation faculty members in the United States were invited to take part in this survey. One hundred forty-one of them responded to the invitations, in which 82 answered all the questions, another 10 faculty members answered some of the questions, while the remaining 49 entered the survey website, consented to take part but did not answer any question. Therefore, this survey received and analyzed the answers from 92 respondents. This was equivalent to a response rate of 11% (92 out of 855 invitations). The number of respondents was higher than the 84 respondents in (Turochy et al., 2013) which also recruited transportation faculty members from ABET-accredited civil engineering undergraduate programs in the United States. The profile of the respondents is summarized in Table 3.

Table 3 Descriptive statistics

Variable	N	Choice	No. of responses	
Age	84	From 26 to 34 years	12	14%
		From 35 to 54 years	46	55%
		From 66 to 64 years	18	21%
		65 years and older	8	10%
Gender	84	Male	58	69%
		Female	24	29%
		Prefer not to disclose	2	2%
Faculty rank	84	Lecturer	5	6%
		Assistant professor	25	30%
		Associate professor	23	27%
		Professor	28	33%
		Other	3	9%
No. of years as a faculty	84	Up to 3 years	15	18%
		Between 4 to 6 years	15	18%
		Between 7 to 9 years	8	10%
		10 years or longer	46	54%
Institution's enrollment	84	<3,000 students	3	4%
		3,000 to 9,999 students	18	21%
		10,000 to 30,000 students	38	45%
		>30,000 students	25	30%
Graduate/PhD courses taught in the Spring 2020 semester	82	0	40	49%
		1	37	45%
		2	5	6%
Undergraduate courses taught in the Spring 2020 semester	82	0	26	32%
		1	34	41%
		2	12	15%
		3	10	12%
Undergraduate course names/contents	46	Transportation engineering	19	41%
		Traffic engineering, operations	4	9%
		Transportation planning	4	9%
		Highway engineering	7	14%
		Pavement engineering	3	7%
		Geometric design	3	7%
		Others	6	13%
Undergraduate class size	46	≤10 students	4	9%
		11 to 20 students	4	9%
		21 to 30 students	7	15%
		31 to 40 students	7	15%
		41 to 50 students	13	28%
		51 to 100 students	9	20%
		≥100 students	2	4%
Teaching assistant	46	≥1	20	43%
		0	26	57%
Transportation research project	88	≥1	64	73%
		0	24	27%
Average no. of research students supervised	82	Undergraduate	2.85	
		Master	2.78	
		PhD	2.54	

4.2 University Supports

University support is critical to its faculty members' success in implementing new teaching and research strategies in such a short time. The support may be in the form of policy change, provision of resources, or both. Table 4 shows the level of support provided by the universities from March to June 2020. Twenty support actions were organized into support for teaching, learning and research. For each action, the respondents rated the support during COVID-19 in five levels: very unsupportive, unsupportive, supportive, very supportive, and not applicable/not sure. Most the respondents rated the teaching and learning supports provided by the universities as "very supportive" or "supportive". For research, most of the respondents rated the supports provided by the universities as "very supportive" or "supportive" but the modes remained at the "supportive" level. They were 12 to 25 respondents who answered "not applicable" for the research actions. They were faculty members who were less active in research.

Table 4 Support by universities

Support actions by university during COVID-19	No. of responses (total = 92)				
	Very un-supportive	Un-supportive	Supportive	Very supportive	Not applicable, not sure
Teaching					
Modifying syllabus during semester	3	6	20	47	16
Preparing online teaching materials	1	3	21	63	4
Conducting online lectures	1	4	18	65	4
Conducting online lab sessions	2	5	23	34	28
Allowing flexibility in class schedule	5	5	30	44	8
Providing software for online teaching	2	6	20	55	9
Permitting change in assessment method	4	4	18	59	7
Introducing S/U grade policy	6	2	14	62	8
Learning					
Setting aside laptop computers for loan	1	9	25	44	13
Providing software tools to facilitate online learning	1	4	27	54	6
Improving accessibility of course website	1	5	23	48	15
Providing technical support for software and hardware issues	1	5	33	49	4
Research					
Writing/submitting research proposals	2	8	39	31	12
Committing/providing matching funds	5	17	36	14	20
Managing project accounts	5	11	40	24	12
Preparing financial reports	3	13	39	22	15
Requesting project modifications	5	9	33	20	25
Preparing/submitting deliverables	6	8	38	15	25
Preparing/submitting scholarly papers	7	12	34	18	21

4.3 Teaching

Figure 1 presents the various changes in teaching modes and the number of respondents who implemented each particular change during COVID-19. The results were the replies from the 46 respondents who taught at least one undergraduate transportation course. The change that was cited the most was “I taught online lectures”, This was selected by 38 (83%) of the respondents. On the other hand, only 10 respondents (22%) taught online laboratory sessions. The low number of online laboratory sessions may be due to (i) some courses did not have a laboratory component; and (ii) a number of faculty members opted to keep in-person laboratory sessions.

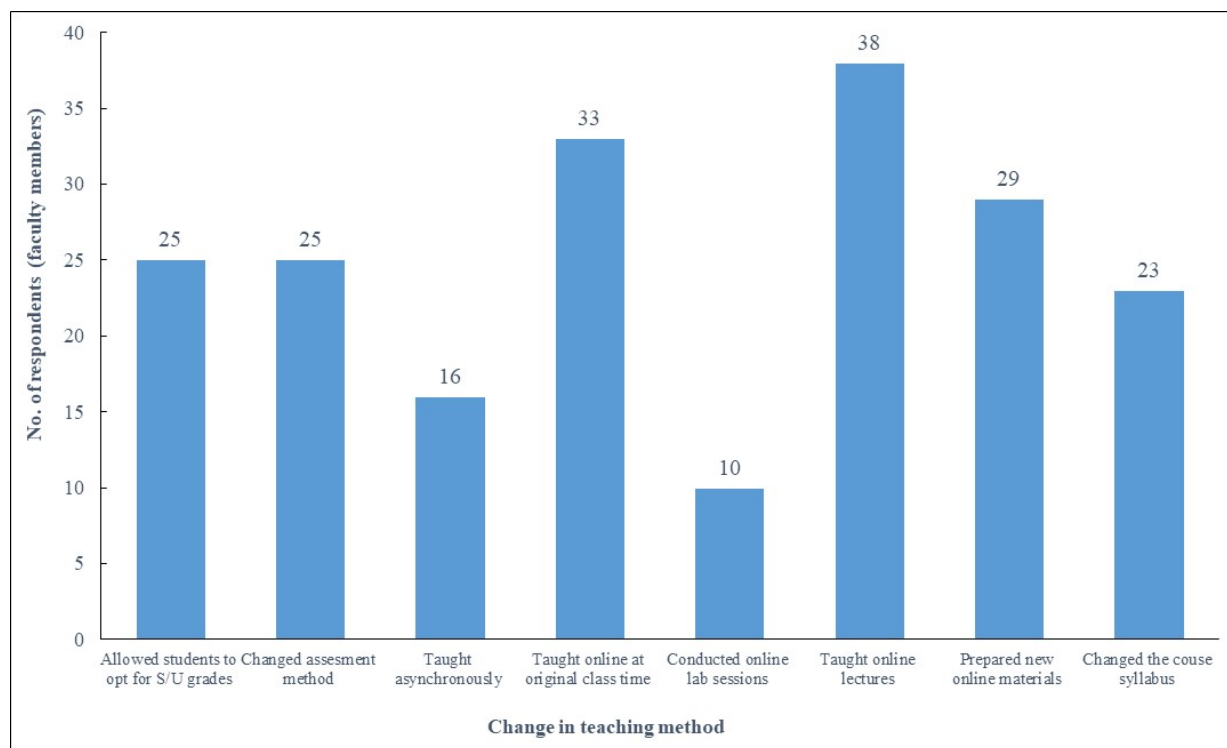
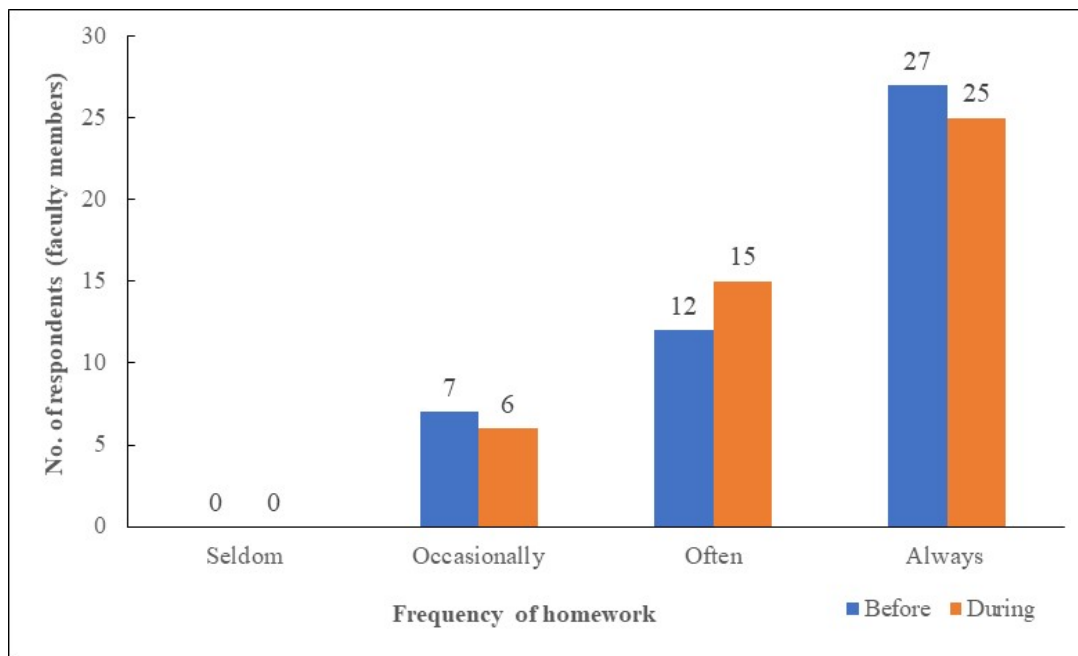


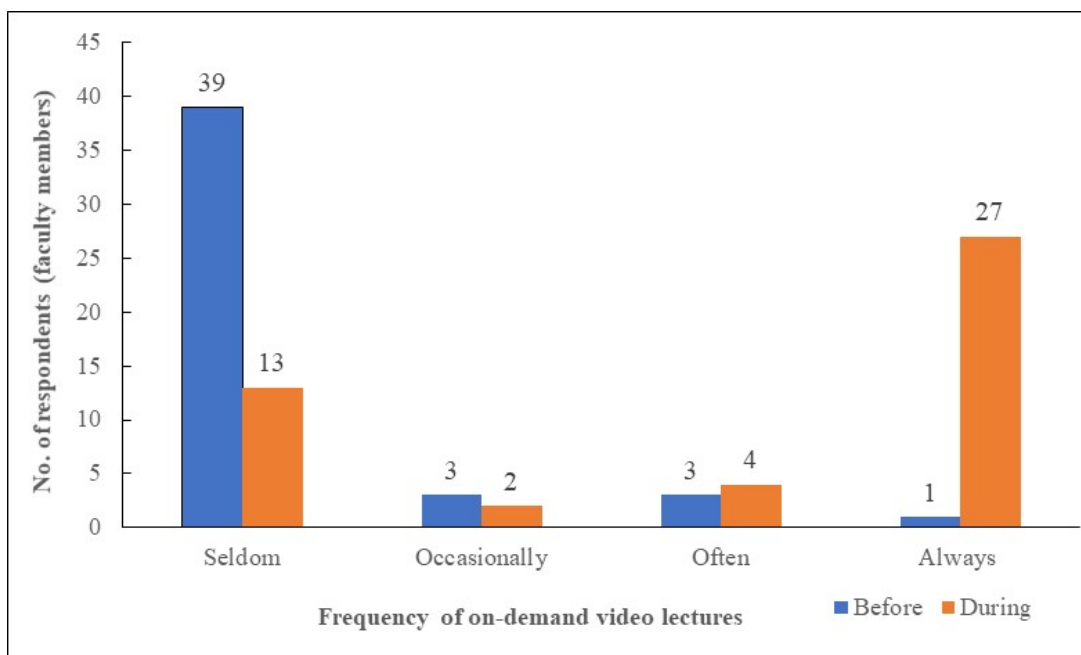
Figure 1 Teaching mode during COVID-19

The survey respondents were asked about the frequency of the various types of teaching activities before and during COVID-19. The teaching activities included; in-person lectures, problem solving sessions, laboratory sessions, and field trips. For each type of teaching activity, the options ranged from seldom, occasionally (once a month), often (once every 2 to 3 weeks) or always (almost every week). Figure 2 compares the frequencies of homework and on-demand video lectures before and during COVID-19. In Figure 2(a), the frequency distributions of homework before and during COVID-19 were mostly identical. Similarly, the frequency distributions for class projects, office hours, tests, and examinations before and during the pandemic were similar. For each of these activities, the frequency distribution was maintained but switched from in-person to online format. Figure 2(b) shows that the frequency of on-

demand video lecture had a drastic change. Two-thirds of the respondents who seldom used on-demand video lectures gave on-demand video lectures almost weekly during COVID-19.



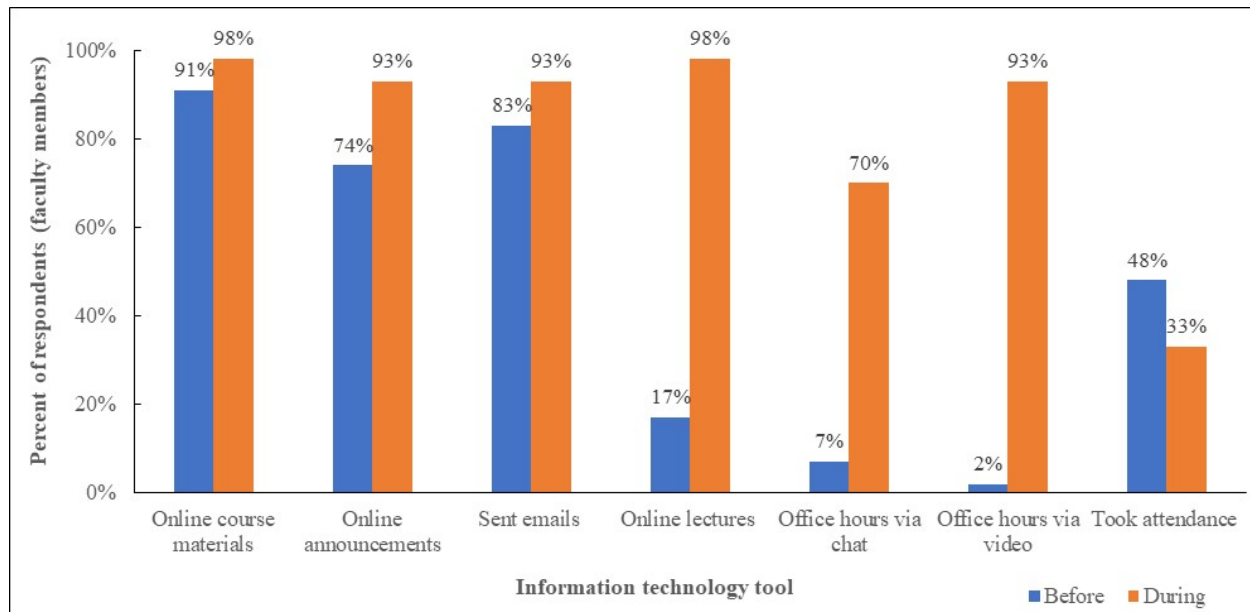
(a) Homework



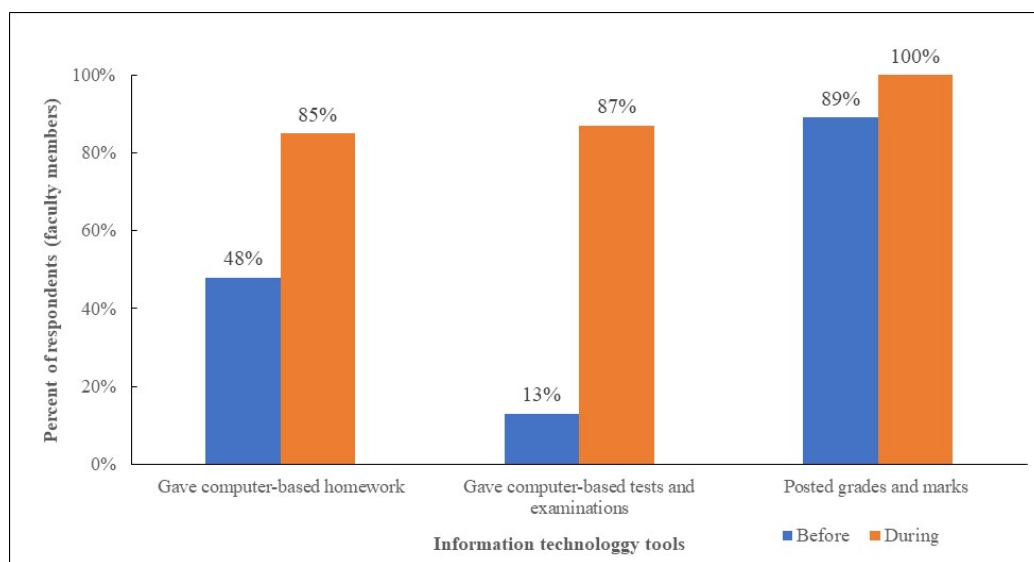
(b) On-demand video lecture

Figure 2 Frequencies of selected teaching activities

Figure 3 displays the calculated percentages of the 46 respondents who used IT tools to engage students. Before COVID-19, more than 74% of the respondents were already using IT tools to post materials, make announcements, and send emails. These activities occurred at least once every two to three weeks. The use of online tools for video meetings with students also increased from a low percentage of 2% to 93% of the respondents. Although homework and examination were given less frequently, at least 85% of the faculty members who responded had given online homework and examinations.



(a) More frequently conducted activities



(b) Less frequently conducted activities

Figure 3 Frequencies of use of information technology tools

Twenty six TA assisted 20 respondents. The TAs performed various duties such as the ones plotted in Figure 4. During COVID-19, the duties that required in-person meetings (office hours, tests and examinations, and problem-solving sessions) were canceled or had their frequencies reduced. Due to most teaching activities being switched to online formats, several respondents assigned new responsibilities to their TAs such as maintaining course website up to date and preparing online teaching materials.

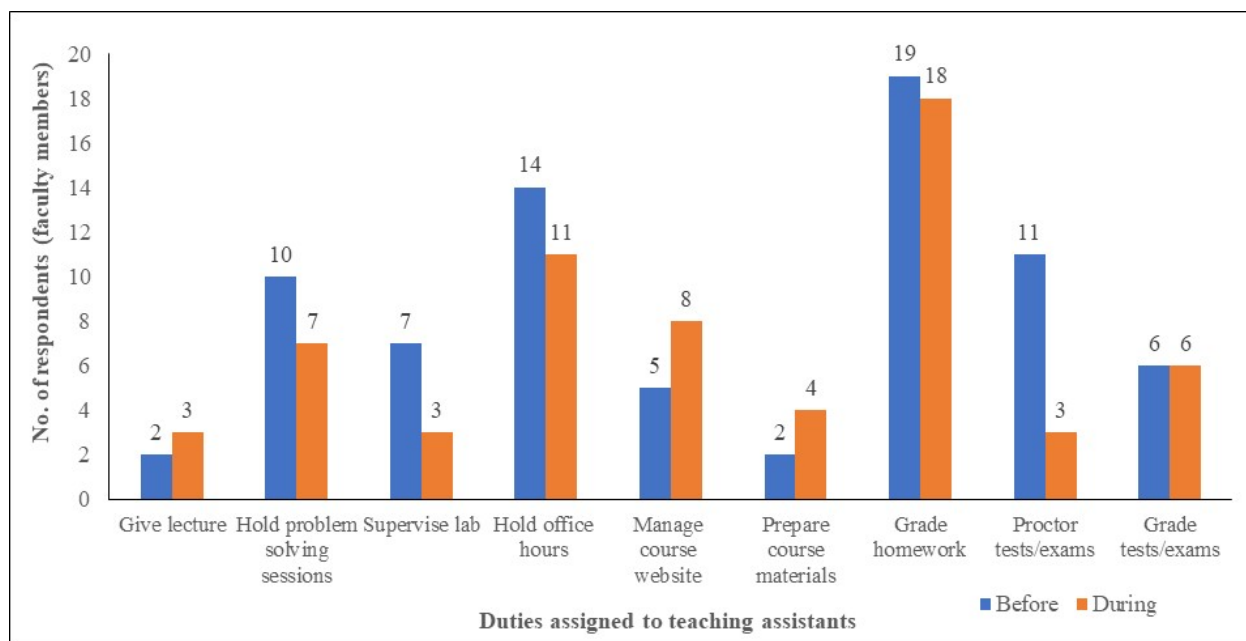


Figure 4 Duties of teaching assistants

4.4 Research

To assess the impacts of COVID-19 on research activities, the respondents were presented with a list of statements. For each statement, the respondents were asked to select from: highly negative impact, negative impact, no impact, positive impact, and highly positive impact. The frequency distributions of the selected choices are summarized in Table 5. The statistics in Table 5 confirmed that COVID-19 had negative and highly negative impacts on their research activities. For access to research facilities, field work, travel to meetings, and recruitment of international research students, the most frequent selected choice was “highly negative impact”. The pandemic also had negative impacts on stakeholder engagement, recruitment, and retention of domestic research students. Unexpectedly, a high number of respondents said that COVID-19 had no impact on project management functions, funding opportunities, availability of research funds from external entity, availability of university matching fund, recruitment and retention of postdoctoral researchers. Overall, COVID-19 appeared to negatively impact more on the faculty researchers’ ability to deliver existing projects rather than the ability to secure new projects.

Table 5 Research activities

For research projects during COVID-19	No. of respondents (total = 62)				
	Highly negative impact	Negative impact	No impact	Positive impact	Highly positive impact
Access to research facilities 24/7	24	15	22	1	0
Ability to do fieldwork	31	16	14	1	0
Ability to perform project management functions	5	21	34	1	1
Ability to travel to project meetings and conferences	48	8	3	1	2
Ability to engage stakeholders	10	37	10	2	3
For future projects					
Funding opportunities	6	23	33	0	0
Availability of research funds from external entities	11	23	27	1	0
Access to university matching fund	12	15	34	1	0
Recruitment and retention of domestic research students	6	25	22	9	0
Recruitment and retention of international research students	38	14	8	2	0
Recruitment and retention of postdoctoral researchers	13	18	29	2	0
Recruitment and retention of faculty	11	19	29	3	0

4.5 Faculty Workload

Two questions in the survey asked each respondent to declare the total working hours per week before and during COVID-19. The choices were given in five-hour increments. [Figure 5](#) compares the total working hours per week before and during COVID-19, from the data provided by 82 respondents.

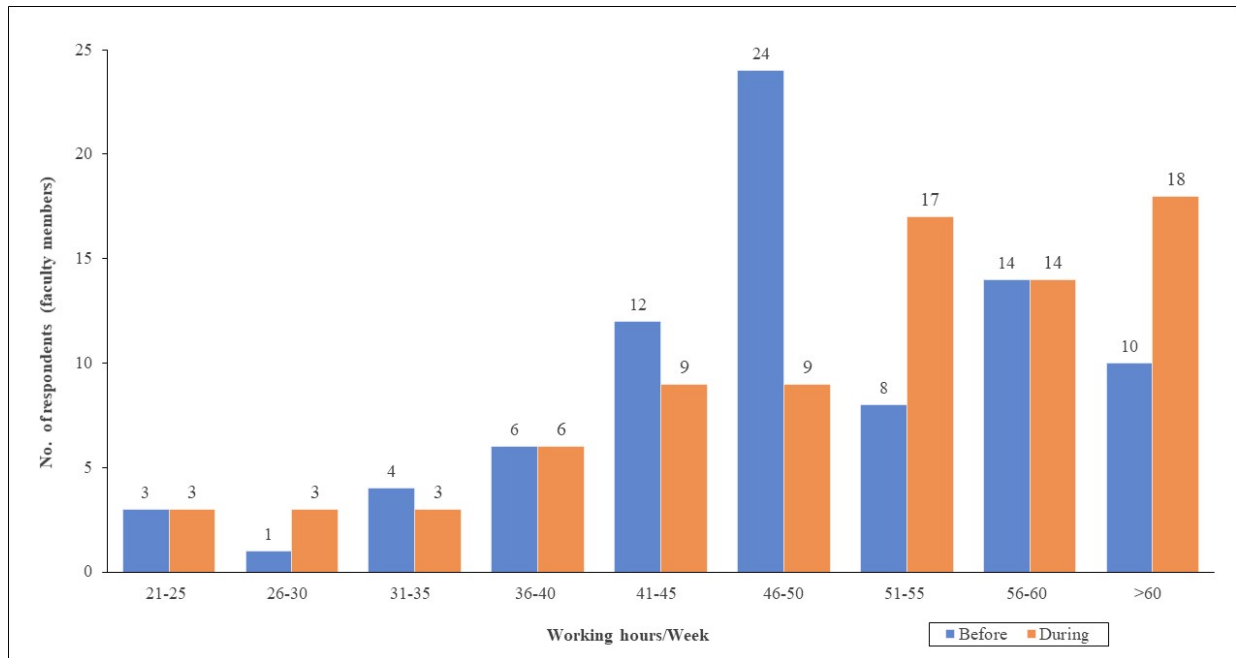


Figure 5 Frequency distribution of faculty work hours

Another two questions asked each respondent how his/her working times were split between teaching, research and service, before and during COVID-19. The average percentages for teaching, research and service are compared in [Table 6](#). Based on the data presented in [Table 6](#), on average, a faculty member worked 48.2 hours/week prior to COVID-19. During COVID-19, the average number of working time was 50.1 hours/week. Before COVID-19 the 48.2 hours/week was divided into 42% teaching, 41% research and 17% service. During COVID-19, the 50.1 hours/week was allocated to 49% teaching, 35% research and 16% service. Therefore, during COVID-19 an average respondent spent additional 4.4 hours/week in teaching but compromised by giving up an average of 2.5 hours/week in research and service time.

Table 6 Faculty workload

Measure	N	Parameter	Before COVID-19	During COVID-19	Change (during- before)
Percent of respondents with working time	82	>40 hours/week	83%	82%	-1%
		>50 hours/week	39%	60%	+21%
		>60 hours/week	12%	22%	+10%
Working Time (hours/week)	82	Mean	48.2	50.1	+1.9
		Median	46 to 50	51 to 55	-
		Mode	46 to 50	>60	-
Average split of working time	82	Teaching	42%	49%	+7%
		Research	41%	35%	-6%
		Service	17%	16%	-1%

5 CONCLUSIONS

5.1 Survey Findings

This research conducted an online survey to understand the impacts of COVID-19 on transportation education and research in the United States. Ninety-two transportation faculty members in the civil engineering departments across the country participated in this survey. The important findings are:

- **University support:** Most of the participating faculty members rated their universities “supportive” or “very supportive” by making policy changes and providing resources to enable them to teach online or hybrid courses. The level of support for research remain the same before and during COVID-19.
- **Teaching of undergraduate transportation courses:** Eighty-three percent of the respondents taught online lectures. Majority of the respondents held online office hours, online problem-solving sessions, gave online homework and online assessments. However, only 22% of the respondents conducted transportation laboratory sessions online. The TAs also switched from in-person to online meetings with students. Some TAs took on the responsibilities of maintaining course website and preparation of online teaching materials.
- **Research activities:** COVID-19 had very negatively impacted laboratory work, field work, travel to meetings and conferences, and recruitment of international graduate students. These had created a challenge some for faculty members to deliver on-going research projects. The majority thought that this pandemic would not impact their research performance. The respondents were equally split between the outlook of future projects.
- **Faculty workload:** During COVID-19, the average working time of the respondents was 50.1 hours/week. This was a net increase of 1.9 hours/week. An average respondent added 4.4 hours/week on teaching. In contrast, research and service time was reduced by 2.5 hours/week.

5.2 Contributions

The survey results create awareness among the university management on the challenges faced by the faculty members in meeting their teaching and research responsibilities during COVID-19. The survey findings will assist transportation engineering faculty members (especially young faculty members) in their teaching and research approaches in the next several semesters. The statistics gathered are useful data that can be used by the university management in formulating response plans in the upcoming semesters and for future pandemics.

5.3 Future Research

The survey is the first step towards understanding the impacts of COVID-19 in transportation engineering education and research. It only surveyed the faculty members in transportation engineering. It should be followed by a survey on students to find out the impact of COVID-19 on their learning experience and challenges. The survey and data analysis approach may be applied to other sub-disciplines in civil engineering.

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APPENDIX – SURVEY INSTRUMENT

Survey: Impact of the COVID-19 Pandemic on Transportation Engineering Teaching, Learning and Research in the United States

Background of this Survey

This survey is a research project supported by the Center for Transportation, Environment and Community Health (CTECH), a U.S. Department of Transportation (USDOT) Tier One University Transportation Center. The objective of this survey is to collect information, from transportation engineering faculty members across the country, the supports provided by the universities, challenges faced and changes in teaching, learning and research during the COVID-19 pandemics in the Spring 2020 semester/quarter. The feedbacks received will be a valuable resource for all stakeholders in formulating better response plans for transportation engineering education and research in anticipation of future pandemics.

You have been invited to participate in this survey because (1) you are a faculty member of an ABET-accredited civil engineering undergraduate program; and (2) your name and contact information have been listed in your university website as a faculty teaching transportation courses and/or conducting transportation research. This survey is open from May 18, 2020 to June 12, 2020. There are 33 questions, which will take approximately 20 minutes to answer. The questions are organized into four sections: A – university support; B – teaching and learning; C – research; and D – academic profile. You may skip section B or section C if one of them does not apply to you. Your participation in this survey is voluntary, and you may withdraw at any time.

The conduct of this survey has been approved by The University of Texas at El Paso's Institutional Review Board (IRB). There is minimal risk associated with your participation during this survey. Demographic data will be collected in section D for research analyses but you will not be asked to provide any personal identification and confidential information. No IP address will be recorded. All the analyses and results will only be presented/published in aggregated form.

If you wish to know the policies for (i) data handling and protection; and (ii) publications and presentations, or any question concerning with this survey, please feel free to ask Dr. Kelvin Cheu at (915)747-5717 or rcheu@utep.edu. For any question concerning the IRB, contact Christina Ramirez, IRB Administrator at (915)747-7693 or cramirez22@utep.edu.

Kelvin Cheu
Professor of Civil Engineering
The University of Texas at El Paso

Rodolfo Rincones
Associate Professor of Education Leadership
The University of Texas at El Paso

Statement of Consent

If you agree to participate in this survey, please click on the button below. If you do not want to participate in this survey, please close this internet browser and exit now.

☐ I have read and understand the information on this consent form, and I agree to participate in this survey.

***Section A. University Support**

A1. The items below are related to the resources to support **teaching**. For each item, select one button under the **before** column and one button under the **during** column to reflect the level of support provided by your university.

1 = very unsupportive

2 = unsupportive

3 = supportive

4 = very supportive

N/A = not applicable, not sure

	Before the COVID-19 pandemic					During the COVID-19 pandemic				
	1	2	3	4	N/A	1	2	3	4	N/A
Modifying syllabus during the semester	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparing online teaching materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conducting online lectures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conducting online lab sessions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allowing flexibility in class schedule	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Providing a variety of software for online teaching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Permitting change in assessment method	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Introducing satisfactory/unsatisfactory grade policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

*A2. The items below are related to the resources to support **learning**. For each item, select one button under the **before** column and one button under the **during** column to reflect the level of support provided by your university.

1 = very unsupportive

2 = unsupportive

3 = supportive

4 = very supportive

N/A = not applicable, not sure

	Before the COVID-19 pandemic					During the COVID-19 pandemic				
	1	2	3	4	N/A	1	2	3	4	N/A
Desktop or laptop computers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer lab on campus with social distancing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Software for online learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Course website	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Study room on campus with social distancing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technical support for software and hardware issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* A3. The items below are related to the resources to support **research**. For each item, select one button under the **before** column and one button under the **during** column to reflect the level of support provided by your university.

1 = very unsupportive

2 = unsupportive

3 = supportive

4 = very supportive

N/A = not applicable, not sure

	Before the COVID-19 pandemic					During the COVID-19 pandemic				
	1	2	3	4	N/A	1	2	3	4	N/A
Writing/submitting research proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Committing/providing matching funds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Managing project accounts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparing financial reports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Requesting project modifications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conducting project evaluations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparing/submitting deliverables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparing/submitting scholarly papers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commercializing research products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A4. Please feel free to share additional comments regarding your university's support for teaching, learning and research. We are particularly interested in the response that may serve as the role model for other universities. Please do not disclose your university's name.

***Section B. Teaching and Learning**

The questions in this section are related to teaching **undergraduate transportation engineering courses**. Please provide information about **ONE** undergraduate transportation engineering course during the Spring 2020 semester/quarter that is most representative of your teaching experience.

To be directed to the next appropriate question, please click a button below to reflect your teaching in the Spring 2020 semester/quarter.

- ☐ I did not teach any undergraduate transportation engineering course in the Spring 2020 semester/quarter.
- ☐ I taught at least one undergraduate transportation engineering course in the Spring 2020 semester/quarter. I am reporting the most representative course in this section.

*** B1. The contents of this course are best described as**

- ☐ Transportation engineering
- ☐ Traffic engineering, operations and analysis
- ☐ Transportation planning
- ☐ Highway engineering
- ☐ Pavement engineering
- ☐ Geometric design
- ☐ Other (type response)

*** B2. The number of students in this course is**

- ☐ 1 - 10
- ☐ 11 - 20
- ☐ 21 - 30
- ☐ 31 - 40
- ☐ 41 - 50
- ☐ 51 - 100
- ☐ 101 or more

* B3. The number of teaching assistants in this course is

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3 or more

* B4. Before this Spring 2020 semester/quarter the number of times I have taught this course is

- ☐ 0
- ☐ 1 or 2
- ☐ 3 or 4
- ☐ 5 or more
-

* B5. How did you adjust your teaching practice in response to the COVID-19 pandemic. (select all that apply)

- ☐ I changed the course syllabus during the semester/quarter
- ☐ I prepared new online teaching materials
- ☐ I taught online lectures
- ☐ I conducted online lab sessions
- ☐ I taught at the original class time, but online
- ☐ I taught asynchronously to allow flexible schedule
- ☐ I changed the assessment method
- ☐ I allowed students to opt for satisfactory/unsatisfactory grades

* B6. The items below are related to **modes of teaching**. For each item, select one button in the **before** column and one button in the **during** column to reflect the usage (frequency) of the different modes in teaching this course.

- 1 = never
- 2 = occasionally
- 3 = often (every 2 to 3 weeks)
- 4 = always (every week)

	Before the COVID-19 pandemic				During the COVID-19 pandemic			
	1	2	3	4	1	2	3	4
Live lecture (face-to-face or online)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
On-demand video lecture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Problem solving, discussion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer lab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical / hands-on lab session	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Field trip, field work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Homework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Group or individual project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consultation / office hours	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quiz, test, exam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* B7. The items below are related to the use of **information technology (IT)** in teaching. For each item, select one button in the **before** column and one button in the **during** column to reflect the usage of IT by you in this course.

1 = never

2 = occasionally

3 = often (every 2 to 3 weeks)

4 = always (every week)

	Before the COVID-19 pandemic				During the COVID-19 pandemic			
	1	2	3	4	1	2	3	4
Online lecture - synchronous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online lecture - asynchronous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Post materials at course website	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Post announcements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Send emails	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual office hours - online chat sessions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Virtual office hours - video meeting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Take attendance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online homework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online tests or exams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Post grades and marks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* To be directed to the next appropriate question, please click a button below to indicate if you have a teaching assistant (TA) for this course.

- ☐ I do not have a TA
- ☐ I have a TA

B8. The items below are related to the roles of **teaching assistants** (TAs). For each column, select the buttons that reflect the duties of your TA **before** and **during** the COVID-19 pandemic.

	Before the COVID-19 pandemic	During the COVID-19 pandemic
Give lecture	<input type="radio"/>	<input type="radio"/>
Hold problem solving sessions	<input type="radio"/>	<input type="radio"/>
Supervise lab class	<input type="radio"/>	<input type="radio"/>
Hold office hours	<input type="radio"/>	<input type="radio"/>
Manage the course website	<input type="radio"/>	<input type="radio"/>
Prepare course materials	<input type="radio"/>	<input type="radio"/>
Grade homework	<input type="radio"/>	<input type="radio"/>
Proctor tests, exams	<input type="radio"/>	<input type="radio"/>
Grade tests, exams	<input type="radio"/>	<input type="radio"/>

* B9. The items below are **barriers to a students' success in learning** during the COVID-19 pandemic. For each item, select a button to reflect your level of concern.

	no concern	somewhat concern	very concern	extremely concern
Distractions at home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to technology equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to broad band internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technology readiness (IT skills)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical and mental well being	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Time management skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plagiarism	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commitment to graduate with a degree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

B10. Please feel free to share additional comments regarding the impact of COVID-19 pandemic on teaching and/or learning.

*** Section C. Research**

The questions in this section are related to your research activities before and during the COVID-19 pandemic. Please provide the following aggregated information about all the **transportation research projects** which you are the **PRINCIPAL INVESTIGATOR (PI)**.

To be directed to the next appropriate question, please select a button below to reflect whether you have a transportation research project from January to May 2020.

- ☐ I do not have a transportation research project
- ☐ I have a transportation research project

*** C1.** The items below are related to **on-going research projects**. For each item, rate the level of impact (or anticipated level of impact) of the COVID-19 pandemic on your research activities.

1 = highly negative impact

2 = negative impact

3 = no impact

4 = positive impact

5 = highly positive impact

	1	2	3	4	5
Ability to access research facilities 24/7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to do field work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to have research team meetings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to perform routine project management functions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to travel to conferences and professional meetings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to engage stakeholders (funding agencies, local community and industry)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* C2. The items below are related to **funding and human resources** for research. For each item, rate the level of impact (or anticipated level of impact) of the COVID-19 pandemic on the resources you need for your research program.

1 = highly negative impact

2 = negative impact

3 = no impact

4 = positive impact

5 = highly positive impact

	1	2	3	4	5
Request for proposals (RFP), new funding opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of external entity's funds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to university's matching funds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recruitment and retention of domestic research students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recruitment and retention of international research students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recruitment and retention of post-doctoral researchers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recruitment and retention of faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* C3. The items below are possible **strategies to meet the challenges** caused by the COVID-19 pandemic on your research program. For each item, select a button to indicate your strategy.

	Implemented	Will implement soon	Not in the plan or N/A
Working remotely from home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Replace face-to-face meetings by video conferences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Request for project modification (e.g., due date, scope of work, or budget)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Encourage local students to apply to graduate school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increase the effort to recruit international students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Develop new research topics and seek new funding opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* C4. The items below are indicators of a faculty's **research performance**. For each item, rate the changes (or anticipated changes) in your research productivity **due to** the COVID-19 pandemic.

	Decreased or declined	About the same	Increased or improved
Total research expenditure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of proposals submitted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of new projects awarded	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of projects completed and delivered	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of scholarly papers submitted to journals (with you as the corresponding author)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of invention disclosures, patents, licensing agreements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of PhD graduated (with you as the committee chair)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

C5. Please feel free to share additional comments regarding the impact of COVID-19 pandemic on your research activities.

*** Section D. Academic Profile**

The questions in this section are related to your **academic profile**. The answers will be used to perform statistical analysis on teaching and research practices **before** and **during** the COVID-19 pandemic. Your answers will not be linked to your identity and will remain confidential.

D1. What is your age?

- ☐ 25 or younger
- ☐ 26-34
- ☐ 35-54
- ☐ 55-64
- ☐ 65 or older

*** D2.** What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to disclose

*** D3.** What is your race/ethnicity? (Adopted from U.S. 2020 and 2010 Census)

- ☐ White
- ☐ African American or Black
- ☐ Asian
- ☐ Native American or Alaska Native
- ☐ Native Hawaiian or other Pacific Islander
- ☐ Interracial
- ☐ Hispanic
- ☐ Other

*** D4.** The following items are related to different **age groups**. For each age group, select the **best** number of persons in the age group who is/are living with you. (excluding you)

	Number of persons				
	0	1	2	3	≥4
0 - 2 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3 - 5 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6 - 11 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12 - 15 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16 - 21 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22 - 65 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Over 65 years old	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* D5. What is your current faculty rank?

- ☐ Lecturer
- ☐ Assistant Professor
- ☐ Associate Professor
- ☐ Professor
- ☐ Other (type response)

* D6. How many years have you been a faculty member, including your previous faculty appointments at other institutions?

- ☐ 0-3 years
- ☐ 4-6 years
- ☐ 7-9 years
- ☐ 10 years or longer

* D7. What is your university's current enrollment classification? (Adopted from Carnegie Classification)

- ☐ Small (< 3000)
- ☐ Medium (3,000 - 9,999)
- ☐ Large (10,000 - 30,000)
- ☐ Extra large (> 30,000)

* To be directed to the next appropriate question, please click a button below:

My university is a "minority serving institution"

My university is not a "minority serving institution"

* D8. What is your university's "minority serving institution" status?

- ☐ Historically Black College or University (HBCU)
- ☐ Hispanic-Serving Institution (HSI) or Institution with Higher Hispanic Enrollment (IHHE)
- ☐ Other "minority serving institution"
-

* D9. How many graduate and PhD courses are you teaching in the Spring 2020 semester/quarter?

	0	1	2	3
Undergraduate course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Graduate and PhD course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* D10. How many research students do you personally advise/supervise in the Spring 2020 semester/quarter?

	0	1	2	3	4	5	>5
Undergraduate student	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Graduate student	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PhD student	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* D11. **Before** this COVID-19 pandemic, how many hours did you work per week?

- ☐ 21-25 hours/week
- ☐ 26-30 hours/week
- ☐ 31-35 hours/week
- ☐ 36-40 hours/week
- ☐ 41-45 hours/week
- ☐ 46-50 hours/week
- ☐ 51-55 hours/week
- ☐ 56-60 hours/week
- ☐ >60 hours/week

* D12. **During** this COVID-19 pandemic, how many hours did you work per week?

- ☐ 21-25 hours/week
- ☐ 26-30 hours/week
- ☐ 31-35 hours/week
- ☐ 36-40 hours/week
- ☐ 41-45 hours/week
- ☐ 46-50 hours/week
- ☐ 51-55 hours/week
- ☐ 56-60 hours/week
- ☐ >60 hours/week