Student Experiences after the move to fully online instruction: A case study of one large public institution

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Abstract— In Spring 2020 and Fall 2020, the College of Engineering at San José State University conducted a comprehensive analysis of the impact of COVID 19 on student learning, student achievement and faculty issues. The first part of the study was designed to survey all Spring 2020 students and faculty in the San José State University College of Engineering about their experiences after the move to 100% online instruction in March 2020. The survey distributed in Spring 2020 was followed by a second survey in Fall 2020 to see how students and faculty adapted to the new online environment. A high number of international and Asian American students responded to the survey. Approximately 1/3 of all students responding were first-generation students. At the onset of the pandemic, the students reported feeling worse or much worse in a several areas including time management, ability to socialize with fellow students, ability to socialize with friends, and their overall psychological well-being. 79% of students reported either a moderate or a great deal of stress related to the shelter in place. This finding is troubling since it indicates the mental well-being of the students. Overall, San José State University College of Engineering students was pessimistic about the next few months, Fall 2020, and their long term plans. In Fall 2020, students reported similar mental health struggles of increased stress and anxiety and decreased motivation. In both surveys, we included questions about the student experience in their classes. Students gave some suggestions on how online instruction could be improved. The top six categories of suggestions were (1) record lectures and post online, (2) use active learning in online classes, (3) utilize better online teaching methods, (4) use Canvas and Zoom more effectively, (5) have better communication with students, and (6) give/use more practice problems. As the San José State University College of Engineering moves to in person instruction in 2021, students felt that a combination of online and face-to-face instruction could provide more face-to-face communication, teacher-student interaction as well as interaction with fellow students, more flexibility, improvement in mental health and well-being, less time in front of the screen, and the ability to perform practical applications.

Keywords—student experience, active learning, COVID-19

I. Introduction and Background

The COVID-19 pandemic forced many universities in the United States to move their classes online in March 2020. This change of instruction, from primarily in person to online, was sudden and quick. At San José State University (SJSU), students and faculty transitioned to remote instruction in less than one week. Most faculty at SJSU had not taught online before and were neither trained nor experienced in online instruction and best practices. Many students were challenged to finish the Spring 2020 semester. San José State University continued with a primarily online instruction in Fall 2020. During the summer semester of 2020, many faculty at SJSU attended training on best practices in online instruction.

The goal of this study was to determine the effect of this sudden change of instruction for engineering faculty and students at SJSU through a survey and interviews at the end of Spring 2020, and a survey after the end of Fall 2020. The results of the faculty survey and interviews at the end of Spring 2020 are published in [1], [2], the students interviews in [3], and a preliminary analysis of the students survey for the respondent from aerospace engineering in [4]. In this paper, we present the results of the surveys administered to engineering students at the end of Spring 2020 and compare them to the results of the survey administered at the end of the Fall 2020 semester. The research questions that we would like to answer in this paper are:

1. What is the impact of COVID19 on students well-being and learning in the SJSU College of Engineering at the end of Spring 2020?

2. What is the impact of COVID19 on students well-being and learning in the SJSU College of Engineering at the end of Fall 2020?

3. Did students in Fall 2020 perceived an improvement in quality of instruction with respect to Spring 2020 due to the training that most of the faculty attended during the Summer 2020 semester?

The impact of COVID 19 has led to a dramatic increase in the number of surveys sent to students about the impact of this pandemic on their lives. Daniels, Das, Hamza, and Leydier [5]

analyzed the early results of a survey sent to students at multiple institutions about the impact of COVID on their experiences. This survey was initiated during the Spring 2020 semester, and collected data about the early effect of the transition to emergency remote instruction. The researchers, from Georgetown University, analyzed the responses from the 516 students from 28 countries who answered the survey in the first week. 479 students completed the question asking about their psychological well-being. Of these respondents, 79% reported feeling "worse" or "much worse" than before COVID 19. Also, 78% felt their ability to pursue their academic goals was "worse" or "much worse" than before COVID 19. The Higher Education Data Sharing Consortium [6] also created surveys for students, faculty, and staff about the impact of COVID 19 on their lives. More than 42,000 students from 65 colleges and universities participated in this survey. 48% of students reported a great deal of stress because of COVID-19.

Several surveys were administered to college students to understand the effects of the COVID-19 pandemic; a full list is kept on the MindWires website [7]. As of May 2021, 29 surveys were included in this list. We summarized the results of the surveys more relevant to the current research [1-4]. A common finding of these surveys was that students struggled in their learning and in interacting with faculty. Students struggles in adjusting to the remote environment, time management, finding a quiet place to work, balancing family and school activities. Students felt disconnected from their classmates and peers, and worried about doing well in college. All the surveys reported an increase with stress and anxiety [8]–[16].

The changes in learning environment therefore represented a challenge for students and faculty, both as classes were moved to the online environment in Spring 2020 and as the pandemic progressed in following semesters. Some colleges allowed students to be back in campus in Fall 2020 for classes and/or in-campus living. A large group of public universities, however, decided to offer mostly online classes in Fall 2020 as well due to safety concerns. San José State University offered primarily online classes in Fall 2020, and did not resume in-person instruction. This paper analyses the experience and learning of engineering students during the entire 2020 as course offering stayed primarily online. The authors believe that it is imperative to investigate how the long-term challenges of remote instruction affects students' well-being and students' learning, and what challenges universities will need to face as students return back to campus.

II. METHODS

The results in this paper are part of a larger study completed at San José State University which looked at the impact of COVID-19 on students and faculty. The College of Engineering at SJSU is one of the largest in the California State University system.

For our student survey in this study, we looked at the questions developed by the researchers at Georgetown [5] and HEDS [6] to develop our own student survey. Because many of the engineering classes at SJSU include laboratories, projects or other group experiences, we wanted to create our own survey to ask students about these experiences.

The survey design was based upon the Lazarus' Theory of Stress; "psychological stress is a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" ([17], p. 19). This theory is defined as a transactional theory of stress and coping and is related to other constructs in psychology including locus of control [18] and self-efficacy [19].

Existing research has shown that the COVID-19 pandemic was stressful to many colleges students who underwent changes that taxed their resources. According to Lazarus and Folkman, there are two phases in psychological stress: appraisal and coping. An individual in a potentially stressful situation first appraises the situation in relationship to their own sense of well-being. "Primary appraisal is an assessment of what is at stake: "Am I in trouble or being benefited, now or in the future, and in what ways?" If the answer to this question is yes, then people categorize the situation as being a threat, a challenge or a loss." [20]. Coping relates to a secondary appraisal of the situation and the individual's self-confidence to have the resources to deal with the situation. The resources can include physical, social supports, financial or psychological resources. According to Lazarus and Folkman [17], coping has two major purposes. First, it regulates the negative emotions that relate to the stressful situation, in this case, the COVID-19 pandemic. Second, students can manage the problem by attempting to change the stressful situation. In the COVID-19 pandemic, since the situation was not usually able to be managed by students, most of the coping relates to students attempting to regulate their emotions or distress caused by the pandemic.

Coping with the COVID-19 pandemic was a unique experience for most students and challenged their regular patterns of coping behaviors. Most students were not prepared for the lifestyle and education changes initiated by the pandemic and found they lacked coping strategies to deal with it. "If the individual does not believe he or she has the capacity to respond to the challenge or feels a lack of control, he or she is most likely to turn to an emotion-focused coping response such as wishful thinking (e.g., I wish that I could change what is happening or how I feel), distancing (e.g., I'll try to forget the whole thing), or emphasizing the positive (e.g., I'll just look for the silver lining)" [21].

A survey was distributed after the end of the Spring 2020 semester to capture the immediate effect of the transition to emergency remote instruction. Students were also surveyed at the end of Fall 2020 to understand how their experiences change as students and faculty adapted to the new reality. The questions contained in the two surveys explore the following aspects: (1) living conditions, (2) psychological well-being, (3) access to technology, (4) instructional environment, (5) interaction with faculty, (6) testing practices in an online environment, and (7) lab classes. In Fall 2020, a few additional questions asked students to compare their experiences between Fall 2020 and Spring 2020, and to reflect about the upcoming transition to in-person classes. In addition to the quantitative data collected through the questions in the survey, we allowed for free-form comments to provide more in-depth representation of the students' experiences.

The responses to the open-ended questions were analyzed using a thematic analysis. Initially, the responses were coded by the team to identify outstanding themes in the students' responses. An iterative inductive stage was used that involved several close readings to provide a holistic perspective of the responses. After an initial identification of the points of interest and interpreted significance, the team performed a step-by-step analysis that described the analytic themes. Lastly, a thematic analysis of the transcript was conducted to identify themes and experiences of the participants.

Some of the questions contained in the Spring 2020 survey were repeated in the Fall 2020 survey. The responses to this common questions were converted to numeric format and their distribution were compared by performing a one-way Anova test, with a significance level $\alpha = 0.05$. The resulting p-value determines whether the response distributions in the Fall 2020 and Spring 2020 semester are statistically different or not.

III. SPRING 2020 SURVEY

There were 6,674 students who were enrolled as engineering majors in Spring 2020; each of these students was sent a survey about their experiences after all the classes at SJSU went online in March 2020.

A. Demographics

Overall, 896 students responded to the survey (314 female and 582 male students). Based on the total number of students enrolled in Engineering classes, our results will be characterized by a margin of error of 3% with a confidence level of 95%. As can be seen in Figure 1, a high number of international and Asian American students responded to the survey. Also, approximately 1/3 of all students responding were first-generation students. Also, the students who responded to the survey had good GPAs (81% of the students have GPAs of 3.0 or better).

The majority of students responding to the survey were upper-division (junior level or higher, 48%) and graduate students (41%). We received responses from all departments in the college. About 52% of students worked during Spring 2020 with most of those students working part-time.

B. Living environment

Most students (81%) did not live with a person with high-risk factors but 19% of the students did. Although the percentage
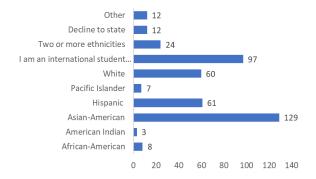

Fig. 1. Ethnicities of students who responded to the Spring 2020 Survey (Spring 2020)

Fig. 2. Student responses to Question: Overall, how much stress are you feeling about the consequences of COVID 19? (Spring 2020)

is low, it still represents a large number of students (169). A large number of students had to care, either part-time (104-12%) or full-time (83-9%), for children or the elderly during the shelter in place. The survey asked the students about their non-school experiences and problems they had after the imposition of shelter in place. Almost 20% of students had difficulties with their living conditions after the COVID 19 shutdown and 22.5% had difficulties in traveling.

C. Well-being

The students reported feeling worse or much worse in a several areas including time management (59%), ability to socialize with fellow students (86%), ability to socialize with friends (78%), and their overall psychological well-being (65%). This finding is troubling since it indicates the mental well-being of the students. We followed this question with more directed questions about student stress. 79% of students reported either a moderate or a great deal of stress related to the shelter in place, which is a very high number of students (see Figure 2). According to Sahu [22], "The COVID-19 outbreak has disrupted the lives of many people across the world. The worldwide rapid increase of infected cases has created a sense of uncertainty and anxiety about what is going to happen. It has also caused a tremendous level of stress among the university fraternity, inclusive of students. This stress may lead to unfavorable effects on the learning and psychological health of students". Overall, SJSU College of Engineering students were pessimistic about the next few months, Fall 2020, and their long term plans. For each of the time frames given, most students felt
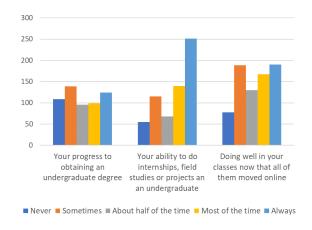

Fig. 3. Student responses to the question: Given the unexpected changes in course instruction after the spread of COVID 19, how often do you worry about the following… (Spring 2020)
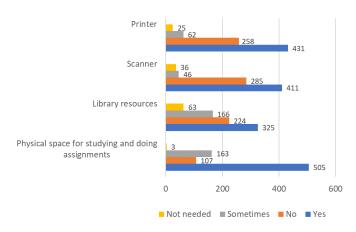
Fig. 4. Student Responses to the Question: Do you have access to the following resources to support your remote learning? (Spring 2020)

worse or much worse about the future. San José State Engineering students had significant worries in several areas including their progress to degree, ability to get internships, and doing well in their classes which were now online (see Figure 3).

D. Access to Technology

Students that responded to the survey have access to computers or laptops and enough Internet access for doing classwork online. However, a high number of students do not have access to a printer, scanner, a physical space for studying and doing assignments, and library resources (see Figure 4). This is particularly important since many faculty had students print out their exams, scan the completed exams, and upload or email them. Most of the students (78%) reported they needed more time to study after the move online in March 2020. Students were split on whether they witnessed more academic dishonesty online. 35% somewhat to strongly disagreed, 34% were neutral, and 31% somewhat to strongly agreed that there was more academic dishonesty due to exams being offered online after the shelter in place.

E. Instructional Environment in Spring 2020

Most of the students (65.3%) responding to the survey took three or more engineering classes in Spring 2020. This is not surprising since most of the students responding were upper-division and graduate students. Students felt that most or all their engineering professors used effective teaching methods after the unexpected move online. 34% of the students felt that their engineering instructors did not use effective methods in all their classes.

Students gave some suggestions on how online instruction could be improved. The top six categories of suggestions were (1) record lectures and post online, (2) use active learning in online classes, (3) utilize better online teaching methods, (4) use Canvas and Zoom more effectively, (5) have better communication with students, and (6) give/use more practice problems.

(1) Record lectures and post online. The largest response was a request for faculty to record and post videos of lectures. Most students asked for this because of connectivity issues.

(2) Use active learning in online classes. The second suggestion that students made was to increase the amount of active learning in online classes through polls, breakout rooms, small group activities, etc.

(3) Utilize better online teaching methods. The third category was to use better online teaching methodologies. In some ways, this category overlaps with the student desire for more active learning online. There was a general feeling among the students that instructors looked at online instruction in the same way as in-person instruction.

(4) Use Canvas and Zoom more effectively. This item relates to better online teaching methods as well. The students felt that some instructors were not utilizing these tools effectively. For example, some instructors asked students to email their homework assignments. Students felt that uploading to Canvas would be more secure and allow students to "know" that their assignments were received. In line with better communication, students want their instructors to use the Canvas calendar and announcements to keep the students informed. As far as Zoom was concerned, students believed that faculty were not using this tool to its fullest potential.

(5) Better communication with students. There were also student concerns about communication from instructors. Most instructors had never taught online, so they didn't realize the importance of frequent communication with students. According to a study done of over 2,000 undergraduates [23], effective communication and instructor availability are hallmarks of both good online and in-person classes.

(6) Give/use more practice problems. Students recommended that faculty do more practice problems live during lectures, perhaps using a digital whiteboard, rather than show PowerPoint slides the entire lecture. Also, students requested more real-world examples of what's mentioned in the lecture.

F. Interactions with Faculty

We asked three questions related to student interactions with faculty after the move online in March 2020. According to the students, most faculty were very available (32%) or somewhat
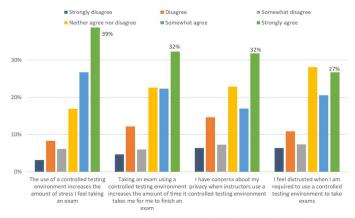

Fig.5 Student responses to the questions about the use of controlled testing environments (Spring 2020).

available (51%) for office hours after the shelter in place. A small number of students indicated that faculty were only available a little (14%) or not at all (3.4%) for office hours.

Mirroring the results on office hours, most students felt that faculty were very helpful (37.4%) or somewhat helpful (45.5%) when the students met with them online after the shelter in place.

The last question we asked was the overall level of student satisfaction with the quality of their faculty interactions last semester in Spring 2020 after the move to 100% online instruction. Most students responded that they were very satisfied (17%) or satisfied (55%) with the quality of their faculty interactions. 28% of students were either dissatisfied or very dissatisfied with their faculty interactions. This result indicates a possible area for improvement.

G. Testing

Most students (76%) that responded to this question had at least one of their instructors use a controlled testing environment (for example, LockDown Browsers, ProctorU, or Proctorio) to take exams. From the results, most students had issues with the use of controlled testing environments. 72% of students agreed that the use of a controlled testing environment increased their stress when taking an exam. Students (63% agreed) also felt that the controlled testing environment increased the time it took to finish an exam. Figure 5 shows the student responses to this question.

H. Lab Classes

The last questions asked students about their experiences in lab classes after the shelter in place. Only 260 students reported having any lab classes in Spring 2020: 143 students had one lab class, 68 students had two lab classes, and 49 students had three or more lab classes. As can be seen in Figure 6, students felt that their instructors did a good job with the lab assignments after the move to 100% online.

IV. Survey after Fall 2020

In Fall 2020, 6,942 students were enrolled as engineering majors in Spring 2020; each of these students was sent a survey about their experiences after the end of the Fall 2020 semester.

A. Demographics

Overall, 408 students responded to the survey (171 female and 237 male students). Based on the total number of students enrolled in Engineering classes in Fall 2020, our results will be
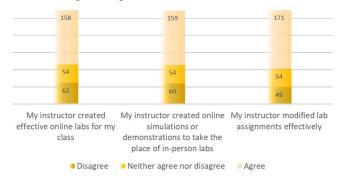

Fig. 6. Student responses to the Question: Consider your most successful online engineering laboratory class in Spring 2020 to answer this question. How satisfied are you with the following since March 2020? (Spring 2020)

Fig. 7. Student responses to Question: Overall, how much stress are you feeling about the consequences of COVID 19? (Fall 2020)

characterized by a margin of error of 5% with a confidence level of 95%. In line with Spring 2020, a high number of international and Asian American students responded to the survey. Also, approximately 40% of all students responding were first-generation students, and 83% had a good GPA (>3.0).The majority of students responding to the survey were upper-division (44%) and graduate students (36%). There were good responses from students from all departments in the College of Engineering. About 28% of students worked during Fall 2020 with most of those students working part-time. The demographic characteristics of the students that responded in the Fall 2020 survey are in line with the Spring 2020 survey.

B. Living environment

Most students (79%) did not live with a person with high-risk factors but 85 (21%) students did. These results are also in line with the Spring 2020 survey. A large number of students had to care, either part-time or full-time, for children or the elderly during the shelter in place. 60 (15%) students reported that they had to care for either children or the elderly full-time and 42 (10%) students reported that they had to care for either children or the elderly part-time, which represent an increase with respect to Spring 2020.

C. Well-being

The survey asked the students about their non-school experiences and problems they had after the imposition of shelter in place. The students reported feeling worse or much worse in a several areas including time management (48%), ability to socialize with fellow students (81%), ability to socialize with friends (80%), and their overall psychological
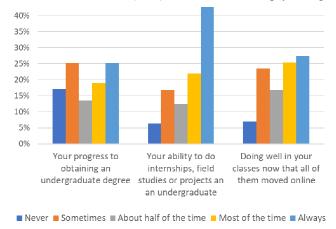

Fig. 8. How often do you worry about... (Fall 2020)

well-being (66%). With respect to Spring 2020, students improved their time management skills and their ability to socialize with fellow students, but their psychological well-being did not improve.

We followed this question with more directed questions about student stress. 84% of students reported either a moderate or a great deal of stress related to the shelter in place, which is a very high number of students and an increase with respect to Spring 2020 (see Figure 7).

Similar to Spring 2020, students were asked to provide some more details about their experience, with an open-ended question. 87 students provided in depth comment in response to this question. A thematic analysis of the responses highlights three main recurring themes: "experience of stress and anxiety" (49% of students – 43/87 responses), "lack of interaction and support from peers and mentors" (26% of students – 23/87 responses), "comments about online teaching" (16% of students – 14/87 responses), "physical living space not conducive to learning" (16% of students – 14/87 responses), "lack of motivation and ability to focus" (15% of students – 13/87 responses). Other negative themes highlighted by the responses include "lack of job", "worrying of transmitting covid-19 to family members", "increase class workload". As a consequence of the pandemic, most students suffer with anxiety, isolation and lack of motivation, with some students reporting an increase in school workload in online classes and loss of jobs. A few students (9% – 8/87 responses) describe a positive experience in light of the pandemic, generally due to "lack of commute", and "improved interaction due to social media".

Students in Fall 2020 were still split on whether they witnessed more academic dishonesty online, but fewer students agreed that they have witnessed more academic dishonesty due to exams offered online (38% somewhat to strongly disagreed, 38% neutral, and 25% somewhat to strongly agreed).

Students made progress in their ability to build an online learning community, even if a large number of students still struggled with it. 44% of the students somewhat to strongly disagree to the sentence "I have an online learning community", 12% are neutral, and 38.7% somewhat to strongly agree. At the end of Fall 2020, San José State College of Engineering students were less pessimistic about the next few months, Spring 2021, and their long-term plans with respect to Spring 2020 responses (see Figure 8).

D. Access to Technology

Students' access to technology improved with respect to the beginning of the pandemic. At the end of Spring 2020, a high number of students did not have access to a printer, scanner, a physical space for studying and doing assignments, and library resources. At the end of Fall 2020, the students that did not have access to this resources decreased 10% compared to Spring 2020.

E. Instructional Environment in Fall 2020

About half of the students (56%) responding to the survey took three or more engineering classes in Fall 2020, compared to 65% students in Spring 2020. A large number of students (14%) decided not to take any class in Fall 2020, compared to only 2.6% of students in Spring 2020. In line with Spring 2020,
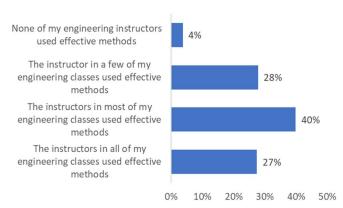

Fig. 9. Student response to the question: How effective was the instruction in your online engineering classes after March 2020? (Fall 2020)

the majority of the students felt that most or all their engineering professors used effective teaching methods after the unexpected move online (see Figure 9).

Students gave some suggestions on how online instruction could be improved. The top five categories of suggestions were (1) promote students' engagement, (2) improve interaction and communication with students, (3) use technology more effectively, (4) improve explanation of material and use problem-solving during class, (5) be more caring and understanding with student. These emerging themes are in line with the responses of the students in Spring 2020.

F. Interactions with Faculty

Student interaction with faculty is one of the key factors for a positive learning environment. According to the students, most faculty were very available (45%) or somewhat available (43%) for office hours after the shelter in place. A small number of students indicated that faculty were only available a little (10%) or not at all (2%) for office hours. In Fall 2020, students felt that faculty were more available than in Spring 2020. Students also felt that faculty in Fall 2020 were more helpful than in the previous semester (41%: very helpful, 47% somewhat helpful, 10% a little, 2% not at all). As a result, students in Fall 2020 were more satisfied with the quality of their faculty interactions with respect to Spring 2020. Most students responded that they were very satisfied or satisfied (80%) with the quality of their faculty interactions, an improvement with respect to 72% in Spring 2020.

G. Testing

In line with the responses of the students in Spring 2020, in Fall 2020 most students (72%) had at least one of their instructors use a controlled testing environment (for example, LockDown Browsers, ProctorU, or Proctorio) to take exams. From the results, most students had issues with the use of controlled testing environments. 80% of students agreed that the use of a controlled testing environment increased their stress when taking an exam (see Figure 10).

H. Lab Classes

We asked students about their experiences in lab classes after the shelter in place. Only 20% of the students indicated that they had in-person engineering labs or in-person research
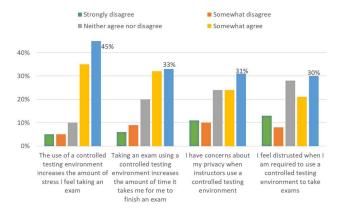
Fig. 10. Student responses to the questions about the use of controlled testing environments (Fall 2020).

experiences or in-person project classes in Fall 2020. Most of these students agree that this on-campus activities were effective.

I. Moving forward

We also asked students to reflect about the advantages of combining face-to-face and online instruction. Students felt that this combination can provide more face-to-face communication, teacher-student interaction as well as interaction with fellow students (64%), more flexibility (62%), improvement in mental health and well-being (61%), less time in front of the screen (58%), and the ability to perform practical applications (52%).

The last question asked students to reflect about the aspects of online learning that they'd like to retain as more classes go in person. A total of 76 students responded to this question, with four main themes emerging from their responses: (1) "record lectures" (34% of students – 26/76 responses), (2) "flexibility to be remote when needed" (28% - 21/76 responses), (3) "keep lectures online" (25% - 19/76 responses), (4) "material and assignments well organized in the course learning platform" (20% - 15/76 students). Students appreciated the possibility of watching a video recording of their lectures: they noted that class recordings have added flexibility to their schedule and represented a valuable study tool. The possibility of re-watching the class allowed students to listen to the professors without excessively worrying about scrambling to take notes, and clarifying points that were missed due to mental exhaustion. Students would like to retain the flexibility of online lectures, in terms of scheduling when classes are asynchronous, especially for students that work outside of class, and in terms of being "anywhere in the world". Many students suggested that SJSU keep a portion of lectures online and asynchronous not to lose this flexibility.

V. DISCUSSION

At the end of the Fall 2020 survey, we asked students to rate their experiences in their online engineering classes in Fall 2020 as compared to their experiences in Spring 2020. Surprisingly, the students' responses are split, with 40% of the students responding that their Fall 2020 was better in all or some of their classes, and 40% that their experiences was similar to their experiences in Spring 2020.

To understand the students' experience in the two semesters more in depth, we compared the student responses to both surveys and looked for changes. The demographical characteristics of the students that responded to both surveys are similar, and we feel confident in comparing the students' responses to the two surveys. A large number of students decreased the number of classes in which they enrolled in Fall 2020 with respect to Spring 2020. In Fall 2020, 56% of the students took more than 3 classes, while in Spring 2020 65% was enrolled in 3 or more classes.

Overall, students experienced stress due to the transition to emergency online teaching in both semesters (see Table I and Table II). The p-value resulting from the one-way Anova test is $p = 0.128$, and the distribution of the responses is not statistically different at the end of the two semesters.

The students' level of stress was similar as the pandemic progressed and classes were kept primarily in an online format at SJSU. In Spring 2020, 79% of the students felt under a moderate or great deal of stress, while in Fall 2020 the percentage increased to 84%. The students' level of stress was similar as the pandemic progressed and classes were kept primarily in an online format at SJSU. In Spring 2020, 79% of the students felt under a moderate or great deal of stress, while in Fall 2020 the percentage increased to 84%.

Despite their high stress level, students in Fall 2020 feel less pessimistic about their future, both when asked to reflect about the next month and their longer-term plans (Table III). In Fall 2020, students are more hopeful about their longer-term plans, with 55% of the students feeling the same or better than before compared to 44%.

TABLE I. STUDENT RESPONSES TO THE QUESTION: "OVERALL, HOW MUCH STRESS ARE YOU FEELING ABOUT THE CONSEQUENCES OF COVID 19?"

	Spring 2020	Fall 2020
A little or no stress	21%	16%
A moderate amount of stress	52%	55%
A great deal of stress	27%	29%

TABLE II. ONE-WAY ANOVA ANALYSIS OF RESPONSES TO THE QUESTION: "OVERALL, HOW MUCH STRESS ARE YOU FEELING ABOUT THE CONSEQUENCES OF COVID 19?" (1: "A LITTLE OR NO STRESS"; TO 3: "A GREAT DEAL OF STRESS")

	Average	Variance
Spring 2020	2.06	0.47
Fall 2020	2.12	0.44

One-way ANOVA p-value (α=0.05)	0.128

TABLE III. STUDENT RESPONSES TO THE QUESTION: "COMPARED TO BEFORE COVID 19, HOW DO YOU FEEL IN GENERAL ABOUT …"

	the next month		your longer-term plans	
	Spring 2020	Fall 2020	Spring 2020	Fall 2020
Much worse or worse than before	52%	39%	56%	45%
Same as before	39%	52%	37%	42%
Better or much better than before	9%	9%	7%	13%

TABLE IV. ONE-WAY ANOVA ANALYSIS OF RESPONSES TO THE QUESTION:: "COMPARED TO BEFORE COVID 19, HOW DO YOU FEEL IN GENERAL ABOUT" (2: "MUCH WORSE THAN BEFORE" TO 6: "MUCH BETTER THAN BEFORE")

	the next month		your long-term plans	
	Average	Variance	Average	Variance
Spring 2020	3.44	0.75	3.34	0.81
Fall 2020	3.61	0.68	3.59	0.97

One-way ANOVA p-value (α=0.05)	1.7E-03	2.2E-05

According to the one-way Anova test (Table IV), the distributions in Fall 2020 and Spring 20202 are statistically significant, with a p-value =1.7E-03 for the next month and p=2.2E-05 for the long-term plans. However, students' overall perception of well-being has not improved from Spring 2020 (65% feeling wore or much worse than before the pandemic) to Fall 2020 (66% feeling wore or much worse than before the pandemic). The distribution regarding the students' perceived well-being are statistically similar, with a p-value = 0.25.

Students have improved their ability to form a virtual learning community, Table V. The one-way Anova test confirms this improvement, Table VI. However, almost half of the students still did not have a virtual support system in Fall 2020 (44% with respect to 53% in Spring 2020).

Students' satisfaction with the quality of their faculty interaction improved in Fall 2020 with respect to Spring 2020, with 79% of the students satisfied or very satisfied with respect to 72%, Table VII.

TABLE V. STUDENT RESPONSES TO THE QUESTION: "PLEASE REFLECT ON THE FOLLOWING ASPECTS REGARDING YOUR LEARNING EXPERIENCE DURING THE ONLINE TRANSITION: 'I HAVE AN ONLINE LEARNING COMMUNITY'."

	Spring 2020	Fall 2020
Disagree	53%	44%
Neither agree not disagree	21%	7%
Agree	26%	39%

TABLE VI. ONE-WAY ANOVA ANALYSIS OF RESPONSES TO THE QUESTION: "PLEASE REFLECT ON THE FOLLOWING ASPECTS REGARDING YOUR LEARNING EXPERIENCE DURING THE ONLINE TRANSITION: 'I HAVE AN ONLINE LEARNING COMMUNITY'." (1: "STRONGLY DISAGREE", 4: NEUTRAL, 7: "STRONGLY AGREE").

	Average	Variance
Spring 2020	3.34	2.70
Fall 2020	3.69	3.23

One-way ANOVA p-value (α=0.05)	0.0014

TABLE VII. STUDENT RESPONSES TO THE QUESTION: "HOW SATISFIED WERE YOU WITH THE QUALITY OF YOUR FACULTY INTERACTIONS LAST SEMESTER IN SPRING 2020 AFTER THE MOVE TO 100% ONLINE INSTRUCTION?"

	Spring 2020	Fall 2020
Very satisfied	17%	22%
Satisfied	55%	57%
Dissatisfied	23%	18%
Very dissatisfied	5%	3%

TABLE VIII. ONE-WAY ANOVA ANALYSIS OF RESPONSES TO THE QUESTION: "HOW SATISFIED WERE YOU WITH THE QUALITY OF YOUR FACULTY

INTERACTIONS LAST SEMESTER IN SPRING 2020 AFTER THE MOVE TO 100% ONLINE INSTRUCTION?" (1: "VERY SATISFIED"; 4: "VERY DISSATISFIED")

	Average	Variance
Spring 2020	2.17	0.59
Fall 2020	2.02	0.52

One-way ANOVA p-value (α=0.05)	0.007

Although the change is minor (7% improvement), it speaks about the extra-effort that most of the faculty have put forward in training and curriculum transformation to adapt to the online format. This improvement is statistically significant, as confirmed by the one-way Anova test (Table VIII).

However, student responses to the question "How effective was your instruction in your online classes" are very similar in the two semesters. In Spring 2020, 66% of the students responded that all or most of their instructors used effective methods, and in Fall 2020 the same responses were given by 67% of the students. The p-value of these distributions also confirms that the distributions of responses are not statistically significant.

In terms of testing, students in Fall 2020 feel that controlled testing increased the amount of stress they experienced while taking exams. In Spring 2020, 72% of the students agreed on the sentence "The use of a controlled testing environment increases the amount of stress I feel taking an exam", and in Fall 2020 this percentage increased to 80% (see Table IX). This result suggests that in-person assessments should be considered as we plan for future semesters of hybrid instruction. Faculty in online classes should explore alternative testing approaches that do not require the use of controlled testing software while ensuring rigor, fairness and minimal cheating, such as open-ended questions, reflection questions, and oral exams.

As San José State College of Engineering moves to more in-person and hybrid learning in Spring 2021 and Fall 2021, faculty and the administration need to provide resources to support students dealing with the long-term challenges of the pandemic. The COVID-19 pandemic has impacted the students' well-being. As well, the university should provide adequate instructional and technological resources that ensures that some of the benefits of online education (such as flexibility and recorded classes) can be maintained when fully in-person. Colleges need in fact to reflect how to maintain the flexibility that all students appreciated and got used to in the past year, and adapt their model to include social interaction, hands-on learning and community building activities. As in many fields of work, it will be hard for students to give up the added flexibility of online learning, especially for the students that work while taking classes (graduate students are particularly sensitive to this topic).

TABLE IX. STUDENT RESPONSES TO THE QUESTION: "THE USE OF A CONTROLLED TESTING ENVIRONMENT INCREASES THE AMOUNT OF STRESS I FEEL TAKING AN EXAM."

	Spring 2020	Fall 2020
Strongly/Somewhat Disagree	9%	10%
Neither agree not disagree	14%	10%
Strongly/Somewhat Agree	72%	80%

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