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Understanding the Academic Shock of Covid-19: How are Students' Perceptions of Online Learning Evolving Over Time?

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Understanding the Academic Shock of COVID-19: How are Students' Perceptions of the Online Learning Evolving over Time?

1. Introduction

COVID-19 outbreak was declared by the World Health Organization (WHO) as a pandemic in March 2020 [1]. Being an infectious disease, COVID-19 is easily transmitted through person-to-person interactions. Starting from the Spring 2020 semester, the imposed spread control measures such as social distancing greatly affected the academic sector. Due to COVID-19 restrictions, more than 4200 institutes of higher education in the U.S. had to transition to online instruction, impacting nearly 26 million students [2]. This abrupt transition created an unprecedented shock across every aspect of academia. Some of the most significant effects were being experienced by teaching faculty and students. While online teaching in higher education is by no means novel, COVID-19 exposed online education to myriad instructors and students with no prior experience. A sudden change in teaching modality for all classes, which happened in a matter of days or weeks depending on the institution, introduced new challenges for instructors who were not prepared for and students who were not familiar with this new environment. At the onset of this change in teaching modality, a survey of more than 800 U.S. higher education faculty and administrators showed that 56% of faculty were required to use teaching methods they had never used before [3]. The problem was exacerbated by the lack of trust in the effectiveness of online classes. A comprehensive survey from more than 4700 faculty in higher education, conducted by the Tyton Partners during the Spring 2020 semester, reported that only 21% of faculty agree that online teaching can help students learn effectively [4].

Recognizing the lack of preparedness for online teaching and realizing the fact that COVID-19 restrictions will be in place beyond Spring 2020 encouraged many colleges and universities to provide proper training and support for faculty and instructors through innovative educational initiatives. For instance, during Summer 2020, California State University, the largest four-year public university system in the U.S., provided comprehensive training that focused on online instruction, ranging from technology workshops to lessons in personalizing the online learning experience [5]. Instructors' increased experience with online teaching in conjunction with the growth in institutional training and support enhanced instructors' view of online education and student learning. A follow-up study conducted by the Tyton Partners during the Fall 2020 semester showed that 49% of faculty agree that online teaching can help students learn effectively, a 28% increase from the Spring study [6].

Faculty in higher education experienced a revolutionary transition in teaching modality over a short time. Today, we are collectively more experienced in online teaching than we were before the pandemic. As the data suggest, we also think higher about online teaching effectiveness, although it is far from being ideal. However, this is only one piece of a complex puzzle. Without a proper understanding of students' online learning experience, the higher education sector may struggle to provide a clear path for the future.

The past literature exploring students' perceptions of online versus in-person classes is mixed. While some studies reported both modalities as equally effective, others suggested that students do not perceive online classes as equivalent to in-person classes [7, 8, 9]. These studies are valuable resources to understand students' perceptions of online learning, but they miss a pivotal determinant: a pandemic! COVID-19 outbreak had a significant multi-dimensional impact on students. A comprehensive survey of undergraduate students at Arizona State University showed that due to COVID-19, 13% of students delayed graduation, 40% lost a job, internship, or job offer, and 29% expected to earn less at age 35 [10]. While the academic shock of COVID-19 on students is undeniable, one question remains unanswered. As instructors become more experienced with online teaching and more prepared for remote delivery, are students' perceptions of online learning evolving over time?

The purpose of the present study is to shed light on students' perceptions of online education in the midst of a pandemic and to investigate whether these perceptions are evolving over time. Notably, this study compares students' interactions, learning, and self-efficacy between online and in-person classes, before and after the collective shift to remote instruction. To my knowledge, this is the first study to employ a repeated cross-sectional data to explore students' perceptions of online learning during the COVID-19 outbreak.

2. Method

2.1. Data Collection

To achieve the objectives of this study, an online survey was distributed at three different times among Civil Engineering and Construction Management students at California State University, Sacramento (CSUS). Initial data collection occurred in the middle of the Spring 2020 semester (third and fourth week of March) when CSUS provided one week for instructors to modify their curriculum materials and course components for remote instruction. At this time, in-person classes had been canceled, and online classes had not yet started, therefore students were not extensively exposed to online teaching. It was essential to act fast because within a limited time frame, a valid questionnaire had to be developed, and the Institutional Review Board (IRB) approval had to be obtained. After developing the survey (discussed in detail in the next section), IRB approval was obtained under exempt review procedure (IRB protocol number: IRB-19-20-257). Upon the IRB approval, the questionnaire was distributed among students via email.

The first round of data collection that occurred in the middle of the Spring 2020 semester (Phase I) was employed to perform "pre-analysis." The second round of data collection (Phase II) occurred at the end of the Spring 2020 semester (second and third week of May) when students had experienced the sudden change to online teaching for their entire classes. This sample was used to perform the first part of "post-analysis." The third round of data collection (Phase III) took place at the end of the Fall 2020 semester (second and third week of December) when students spent their entire Fall semester in a virtual mode. At this stage, students were

extensively exposed to online learning. This sample was used to perform the second part of "post-analysis."

2.2. Online Survey

Literature regarding students' perceptions of online learning was carefully evaluated, and questions were primarily developed in accordance with previous work [11, 12, 13]. Recommendations from the literature were also considered to validate the survey design and reduce total survey errors [14]. Qualtrics was used to develop the online survey. The final survey consisted of five sections: (1) Students' information, (2) students' general perceptions of online classes, (3) students' perceptions of interactions in online classes, (4) students' perceptions of learning in online classes, and (5) students' self-efficacy. For the latter four sections, students were asked to share their thoughts about online learning on a seven-point Likert scale ranging from "strongly disagree" to "strongly agree."

2.3. Participants

Collected data were initially processed to remove partial responses. Table 1 presents a summary of students' characteristics in all three phases of data collection. After the initial data reduction, Phase I, Phase II, and Phase III included complete responses from 150, 134, and 142 students, respectively. The final dataset mostly consisted of junior and senior students with some prior experience in online classes. This sample is considered one of convenience, which is common in qualitative research [15]. A random sample was impossible because of the challenges in getting students to participate in such research in a short time.

Table 1. Descriptive Summary of Students' Characteristics

		Phase I	Phase II	Phase III
Number of Participants		150	134	142
GPA	**Mean**	3.12	3.10	3.29
	(SD)	0.45	0.48	0.45
Age	**Mean**	23.07	23.71	24.59
	(SD)	4.40	4.67	5.20
Gender	**Female**	47 (31.3%)	41 (30.6%)	32 (22.5%)
	Male	102 (68.0%)	93 (69.4%)	108 (76.1%)
	Other	1 (0.7%)	0 (0.0%)	2 (1.4%)
Class Standing	**Freshman**	6 (4.0%)	4 (3.0%)	2 (1.4%)
	Sophomore	17 (11.3%)	14 (10.4%)	7 (4.9%)
	Junior	91 (60.7%)	68 (50.7%)	72 (50.7%)
	Senior	35 (23.3%)	48 (35.8%)	49 (34.5%)
	Graduate	1 (0.7%)	0 (0.0%)	12 (8.5%)
Online Classes in Past?	**Yes**	111 (74.0%)	96 (71.6%)	125 (88.0%)
	No	39 (26.0%)	38 (28.4%)	17 (12.0%)

3. Results

Data were analyzed in four parts, reflecting the type of perceptions that were explored. In addition to a visual inspection, a Chi-squared test for trends in proportions was employed to investigate whether there is a statistically significant linear trend in the proportion of responses across three phases of data collection. Many statistical methods have been developed to analyze trends in categorical data. Chi-squared test for trends in proportions was selected because of the advantages it proposes compared to the other methods. For example, unlike the Chi-squared test for association, the Chi-squared test for trends in proportions considers the order of categories and attaches numerical values to them. It also provides a more straightforward statistical analysis compared to the Cochran-Armitage trend test. A comprehensive discussion about statistical methods for trend detection and analysis in categorical data could be found in references 16. The chi-squared test for trends in proportions evaluates the evidence against the assumption that there is no linear trend in the proportion of responses across three phases of data collection (null hypothesis). In this study, 0.05 was selected as the level of significance.

3.1. Students' General Perceptions of Online Classes

Students were initially asked about their general perceptions of online classes. Five questions were included in this section:

> To what extent do you agree or disagree with the following statements about online classes: Compared to in-person classes

- *General1* – Online classes are generally easier.
- *General2* – Online classes have a higher quality.
- *General3* – It is easier for students to cheat in online classes.
- *General4* – Online classes provide more flexibility.
- *General5* – Online classes require more of student's time.

Figure 1 shows the proportion of responses to general questions across all three phases. Results of Chi-squared test for trend in proportions showed that over time, there was statistically significant growth in rate of: (1) “Strongly Disagree” responses to *General1* (p-value = 0.042), (2) “Strongly Agree” responses to *General3* (p-value = 0.046), (3) “Strongly Agree” responses to *General4* (p-value < 0.001), and (4) “Strongly Agree” responses to *General5* (p-value = 0.003).

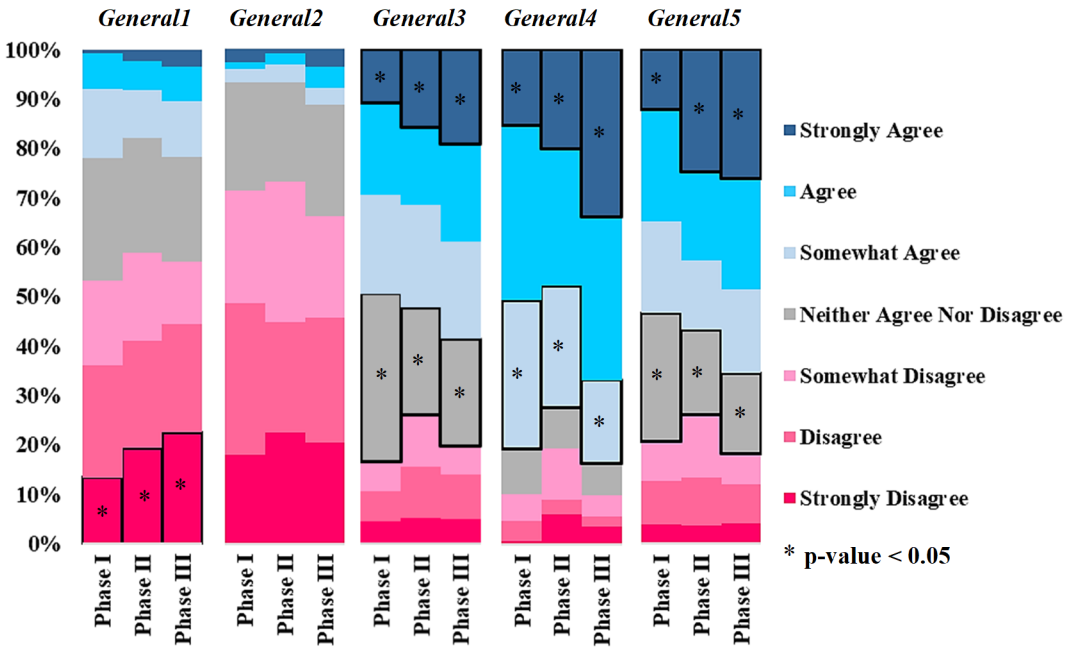

Figure 1. Students' Perceptions of Online Classes: General

Results of the Chi-squared test for trend in proportions showed that over time, there was also a statistically significant decline in the rate of: (1) "Neither Agree Nor Disagree" responses to General3 (p-value = 0.017), (2) "Somewhat Agree" responses to *General4* (p-value = 0.009) and (2) "Neither Agree Nor Disagree" responses to *General5* (p-value = 0.035). No significant trends were observed in *General2*.

3.2. Students' Perceptions of Interactions in Online Classes

The second set of questions explored students' perceptions of interactions in online classes. Five questions were included in this section:

> To what extent do you agree or disagree with the following statements about online classes: Compared to in-person classes

- *Interact1* – I would be less engaged in an online class.
- *Interact2* – I would be less attentive in an online class.
- *Interact3* – I would be less willing to express my opinions in an online class.
- *Interact4* – I would have fewer chances to interact with the instructor in an online class.
- *Interact5* – I would have fewer chances to interact with my classmates in an online class.

Figure 2 shows the proportion of responses to interaction questions across all three phases. Results of the Chi-squared test for trend in proportions showed that over time, there was statistically significant growth in the rate of "Agree" responses to *Interact1* (p-value = 0.050) and a statistically significant decline in "Somewhat Agree" responses to *Interact5* (p-value = 0.032). No significant trends were observed in *Interact1*, *Interact2*, and *Interact3*. No significant trends were observed in *Interact2*, *Interact3*, and *Interact4*.

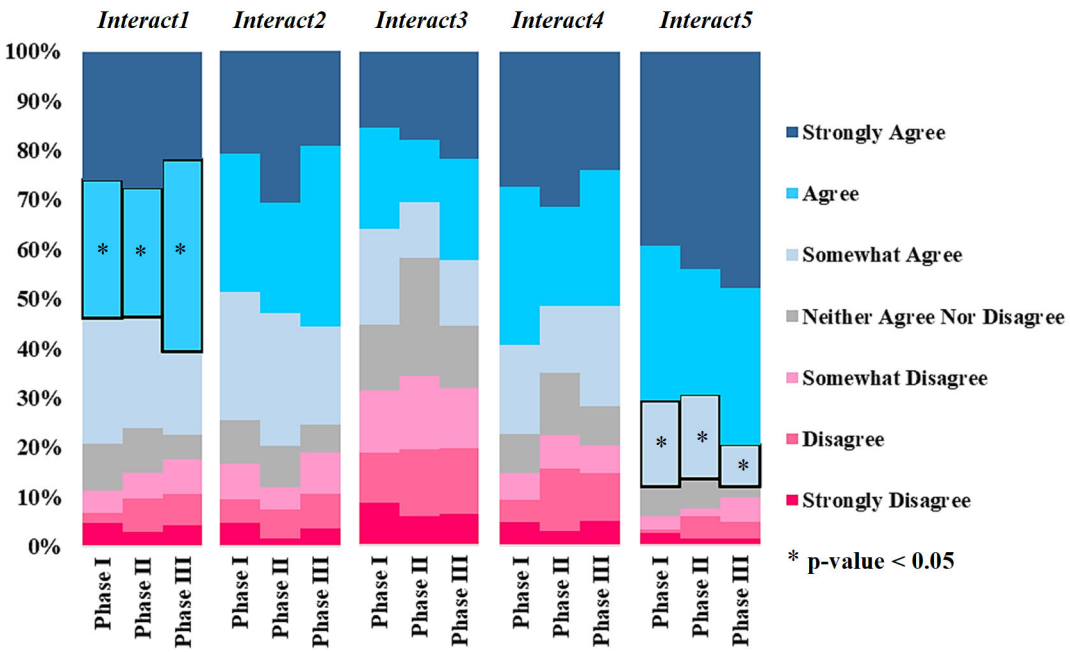

Figure 2. Students' Perceptions of Online Classes: Interactions

3.3. Students' Perceptions of Learning in Online Classes

The third set of questions explored students' perceptions of learning in online classes. Five questions were included in this section:

> To what extent do you agree or disagree with the following statements about online classes: Compared to in-person classes
- *Learn1* – Online classes provide an effective learning experience.
- *Learn2* – Students learn more in online classes.
- *Learn3* – The amount of material that is presented to students in online classes is greater.
- *Learn4* – Students should be more self-motivated in online classes.
- *Learn5* – Students should be more willing to teach themselves in online classes.

Figure 3 shows the proportion of responses to learning questions across all three phases. Results of Chi-squared test for trend in proportions showed that over time, there was statistically significant growth in rate of: (1) "Agree" and "Somewhat Agree" responses to *Learn1* (p-value = 0.033 and 0.029, respectively), (2) "Agree" and "Disagree" responses to *Learn2* (p-value = 0.006 and 0.044, respectively), (3) "Strongly Agree" responses to *Learn3* (p-value = 0.044), and "Strongly Agree" responses to *Learn5* (p-value = 0.021). There was also statistically significant decline in rate of: (1) "Somewhat Disagree" and "Neither Agree Nor Disagree" responses to *Learn2* (p-value < 0.001 and p-value = 0.007, respectively), and (2) "Agree" responses to *Learn5* (p-value = 0.007). No significant trends were observed in *Learn4*.

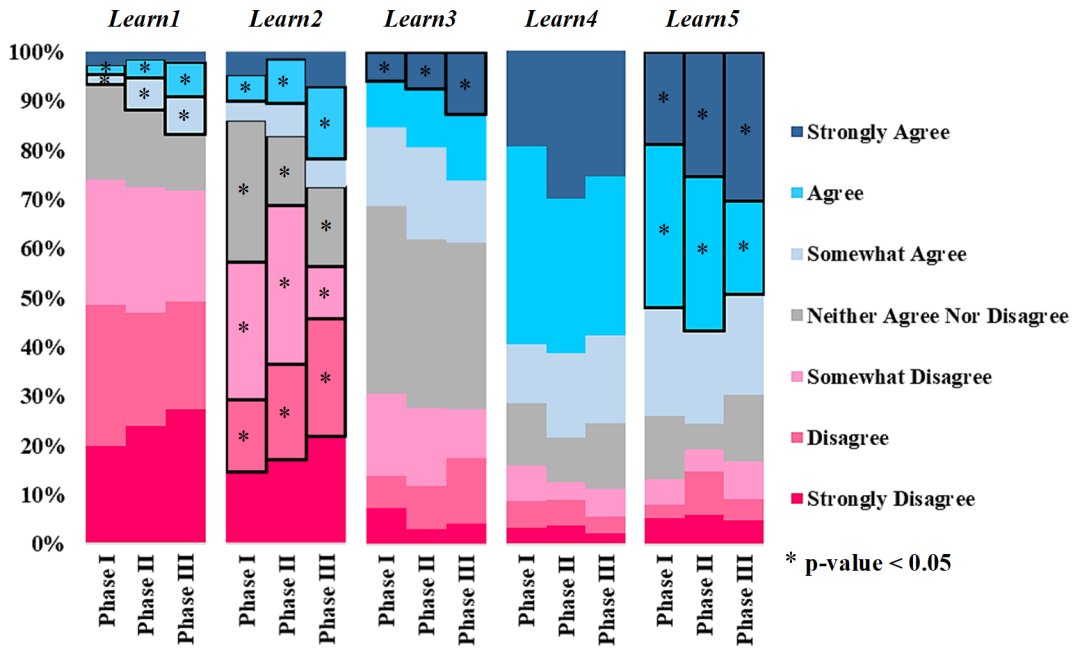

Figure 3. Students' Perceptions of Online Classes: Learning

3.4. Students' Self-Efficacy

The final set of questions explored students' self-efficacy. Five questions were included in this section:

To what extent do you agree or disagree with the following statements about yourself:

- *SE1* – I can master the content in the engineering-related courses I am taking this semester.
- *SE2* – I can master the content in even the most challenging engineering course.
- *SE3* – I can do an excellent job on engineering-related problems and tasks assigned this semester.
- *SE4* – I can learn the content taught in my engineering-related courses.
- *SE5* – I can earn a good grade in my engineering-related courses.

Figure 4 shows the proportion of responses to self-efficacy questions across all three phases. Results of the Chi-squared test for trend in proportions showed that over time, there was statistically significant growth in the rate of "Strongly Agree" responses to SE4 (p-value = 0.040) and also a statistically significant decline in the rate of: (1) "Somewhat Agree" responses to SE1 (p-value = 0.038), and (2) "Disagree" responses to SE2 (p-value = 0.042). No significant trends were observed in *SE3* and *SE5*.

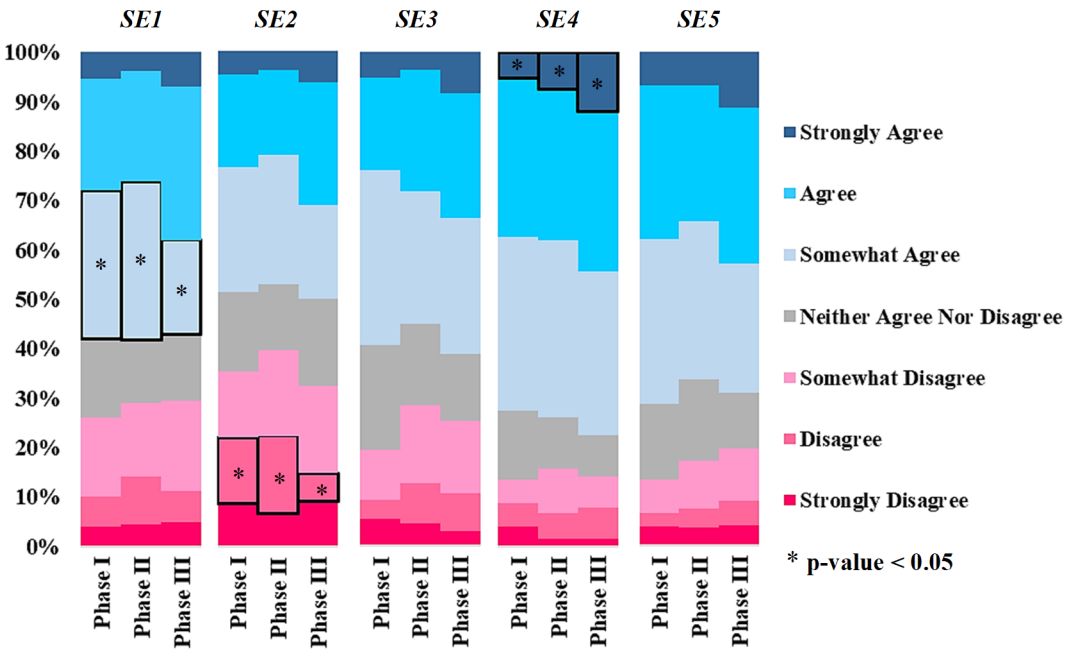

Figure 4. Students' Self-Efficacy

4. Discussion

Prior to the collective transition to remote instruction (Phase I), when students were asked about their *General* perceptions of online classes compared to in-person ones, they mostly believed that online classes provide higher flexibility, but they are not easier, and they require more of students' time. The proportion of students with this belief increased over time. For instance, while in Phase I, 12.0% of students strongly agreed with online classes requiring more time, this proportion increased to 24.6% and 26.1% in Phase II and Phase III, respectively. This growth could be explained, in part, by what is observed in *Learn* questions. Over time, more students believed that a greater amount of materials are presented in online classes. The majority of students also thought that they should be more willing to teach themselves in online classes. This sends a clear message to instructors. The change in teaching modality should not necessarily change the amount of materials covered in a specific course. Instructors should be cognizant of students' workload. Online teaching makes it more appealing to employ novel pedagogical approaches, such as flipped classroom models, which could lead to higher burden for some students if implemented imperfectly. Instructors should balance learning objectives and students' contributions to ensure no one is lagging behind.

The observed trends in *General3* perceptions could be of most significant concern with regard to online teaching. In *General3*, students were asked whether it is easier to cheat in online classes. While in Phase I, 49.3% of students agreed (at various levels) with such statement, this proportion increased to 52.3% and 58.5% in Phase II and Phase III, respectively. This growth does not necessarily imply growth in academic misconduct. However, this is an alarming statistic because it shows the inefficiency of employed alternatives. The present study does not document instructional practices among Civil Engineering and Construction Management faculty at CSUS.

However, from conversations with colleagues, I am aware that all faculty were concerned primarily with online exams' integrity and security. We all, therefore, implemented some control measures in our classes, among those, are encouraging students to share their camera during exams (cannot be required at CSUS), employing "Canvas LockDown Browser," and randomizing questions in Canvas quizzes. The growth above in proportion of students who believed it is easier to cheat in online classes raises serious doubts about these proctoring alternatives' competence. In an online setting, instructors might want to consider alternative assessment tools to replace exams. For example, embedding assessment throughout a project could lower academic dishonesty concerns in the online environment.

The quality of online classes was also investigated. *General2* asked students whether online classes have a higher quality compared to in-person ones. As expected, in all three phases, most students disagreed (at various levels) with this statement. Although the disagreement rate declined over time (Phase I: 71.3% vs. Phase III: 66.2%), the trend was not statistically significant. The critical finding here is the similarity between responses in *General2*, and *Learn1*, and *Learn2,* suggesting a one-to-one mapping between perceptions of quality and learning. In *Learn1*, students were asked whether online classes provide an effective learning experience, and in *Learn2*, students were asked whether they learn more in online classes. While most students disagreed (at various levels) with these two statements, growing trends were observed in agreement. For example, while in Phase I, 6.7% of students agreed (at various levels) with online classes providing an effective learning experience, this proportion increased to 11.9% and 16.9% in Phase II and Phase III, respectively. As was mentioned in the introduction section, recent literature shows that while most instructors are still skeptical about online learning, a growing trend has been observed in their trust in the effectiveness of online learning [4, 6]. Findings of the present study suggest that while most students also view online learning as inferior to in-person learning, there is a growing trend in their trust in online learning effectiveness.

Students' engagement with class activities and proper interactions with the instructor and classmates are keys to their effective long-term learning. Therefore, trends in students' interactions in online classes were also investigated. In an online environment, students found it most challenging to interact with their classmates and instructors. In all three phases, more than 86% of students agreed (at various levels) with having fewer chances to interact with classmates, and more than 65% agreed (at various levels) with having fewer chances to interact with instructors. The majority of students also reported being less engaged, less attentive, and less willing to express their opinion in online classes than in in-person ones. This is a critical finding because recent research in engineering education suggests that interactive, constructive, active, and passive learning environments are decreasingly effective [17]. An example of passive learning is taking notes without any substantial cognitive engagement in that process. In contrast, an example of interactive learning is a group of students working on problems together that are harder than they can solve individually. While it is unrealistic to start developing online classes solely based on constructive and interactive learning materials, careful attention should be paid to structure online lectures so that interactive and constructive learning environments are frequently considered. Current online platforms include technical components (e.g., Zoom polls

and breakout rooms and Canvas discussion forums and peer-evaluations), making it possible to promote interactive and constructive learning in online classes, which could eventually enhance the learning experience of the online environment.

Academic self-efficacy was also investigated in this study. Academic self-efficacy defines a student's judgments about their ability to successfully attain educational goals [18]. The influence of self-efficacy on learning and performance has been widely applied and tested in educational settings. In theory, self-efficacy is hypothesized to influence behaviors and environments and, in turn, to be affected by them [19]. Examining academic self-efficacy while considering the change in teaching modality can contribute to a broader understanding of students' academic performance. The present study's findings suggest a minimal change in students' self-efficacy before and after the collective shift to remote instruction. Very few trends were observed to be statistically significant, and between-group variations faded the overall effect of those trends. From an educational standpoint, this finding is appealing. Although students perceived online learning to be less effective, this change in the teaching environment did not impact students' belief in their academic abilities.

5. Summary and Conclusion

Online teaching in higher education is by no means novel. However, COVID-19 exposed online education to myriad instructors and students with no prior experience. Within a short time frame, instructors had to pivot to a new form of instruction, and students had to cope with a new learning environment. The present study sheds light on the trends in students' perceptions of online learning over time. While most students viewed online learning as inferior to in-person learning, a small, growing trend in their trust in online learning effectiveness was documented. Some concerning trends were also observed. Over time, more students found it easier to cheat in online classes, and more students reported an increase in the amount of materials presented in online classes. Apart from the temporal trends, most students in all three phases reported being less engaged, less attentive, and less willing to express their opinion in online classes than in in-person ones. No changes were observed in students' self-efficacy.

It is unrealistic to assume the same level of online teaching in higher education as there was before the pandemic. Moving forward, it is likely that more students will consider online classes, and more educators will consider remote delivery or at least some combinations of modalities. It is, therefore, vital to obtain a detailed understanding of how pedagogical approaches and students' learning interact. Future studies should investigate students' perceptions of online learning in conjunction with instructional practices. For example, the difference between synchronous and asynchronous delivery needs to be further evaluated, and the effect of online interactive and constructive practices on students' learning needs to be carefully measured.

No one in higher education was expecting what happened during the Spring 2020 semester. With all the shortcomings, we evolved over time, and we survived. However, the impacts of COVID-

19 on higher education will linger beyond this transition period. The question is, are we ready for the future? The answer is not clear given that there are multiple contributing factors. However, to better prepare for the future, we need to precisely document and evaluate our collective experience during the pandemic and share the lessons learned. The present study attempted to take a step in this direction. More studies are required to evaluate the impact of COVID-19 on every sector and stakeholder of higher education.

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