# Online and In-Person Learning Preferences during the COVID-19 Pandemic among Students Attending the City University of New York

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**The widespread disease outbreak of SARS-CoV-2 in early 2020 elicited mandated shutdowns of all facilities not considered essential to include academic institutions. Many educational institutions had to find a way to transition into online learning modalities rapidly. This study investigates whether a relationship between students' perceptions of online learning and their academic achievement during the coronavirus outbreak exists. We hypothesized that (i) students would rate the online modality more negatively than the in-person module, (ii) STEM courses would be rated more negatively than non-STEM courses, and (iii) there was a positive correlation between grades achieved and student perceptions of the online course modality. The study found that students rated online courses more negatively than in-person courses. There were significant differences in student achievement and perception based on the course type. The study found a weak yet positive relationship between student achievement and perception of learning modality. Future studies should continue to evaluate the effects of mandated online learning on the mastery and achievement of learning outcomes. The implications from these findings can help institutions improve e-learning modules.**

**KEYWORDS** COVID-19, online-learning, distance learning, academic achievement, student perceptions

## INTRODUCTION

The SARS CoV-2 (COVID-19) disease outbreak elicited a global pandemic that ensued in early 2020. At its onset, researchers knew little about the disease, and no vaccine was introduced nor available to stop nor prevent the spread of COVID-19. Weeks into the pandemic, many studies and clinical trials were under way in the United States, United Kingdom, and China (1–3) to understand and combat this deadly disease. Meanwhile, the pandemic led to shutdowns of all educational institutions to ensure the safety of both students and employees. To maintain the continuity of higher education, it became critical for universities and colleges to institute online learning as the primary modality. For this study, we defined the in-person learning modality as having all required class meetings occurring on campus during the scheduled class time (4). Online courses are defined synchronous or asynchronous classes, in which all required contact hours are taking place online (4). During the onset of the pandemic, online learning increased sharply among CUNY's 23 colleges. Specifically, at Bronx Community College, fully online courses increased 94.16% from Fall 2019 to Fall 2020; meanwhile, in-person courses decreased by 90.81% (Fig. 1). This shift prompted us to investigate the academic effects of the mandated online learning modality employed during the global pandemic among students within CUNY. More specifically, this study investigated students' perceptions of the online learning modality and their achievement within it among those who majored in science, technology, engineering & mathematics (STEM) compared to non-STEM majors.

### Student perceptions of online learning before and during the pandemic

As technology has dramatically advanced in the past several decades literature on students' perceptions of online learning compared to in-person learning. We explore a brief literature review of student perceptions of online learning before and during the SARS-CoV2 pandemic.

Pre-pandemic, community college students revealed that the significant factors behind enrollment in online courses were their perception of the course subject, flexibility, comfortability, and convenience (5). Courses perceived as "easier," such as the humanities, were preferred by students to be taken online. In contrast, courses perceived to be more
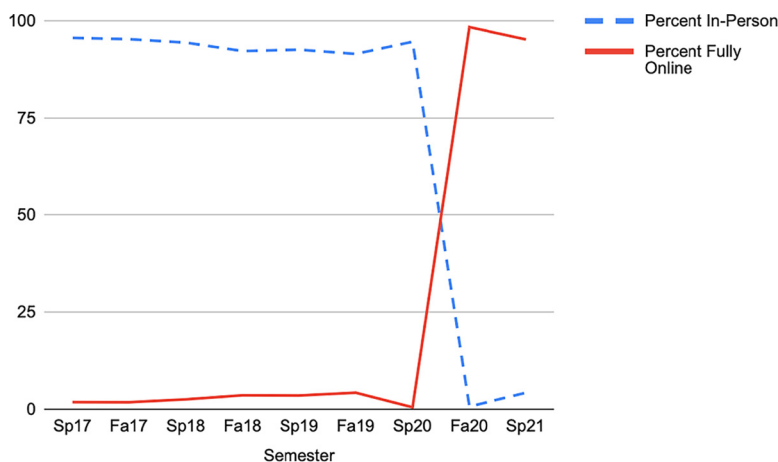
FIG 1. Number of students enrolled in online courses versus in-person courses.

difficult, typically STEM and foreign languages, were favored to be taken in-person (5). Courses dedicated to the students' declared major or considered attractive were also preferred in-person (6).

However, the outbreak of SARS-CoV2 led to an abrupt shift to the online learning modality despite students' perceptions or preferences. Studies conducted during the pandemic on online learning revealed students' perception of the courses trended negatively (7–10). The presence of the instructor and learning activities implemented in the class affected the satisfaction ratings among students (8). Students perceived negative aspects of online learning as poor instruction and interaction with lecturers and classmates (8). However, positive perceptions toward online learning were expressed when instructors implemented teaching strategies such as electronic books and articles in the course. Similar to online learning outcomes identified pre-pandemic, students perceived the benefits of online learning as time-saving and the flexibility of classes (8).

**Challenges with online learning before and during the pandemic**

Pre-pandemic, there were consistent challenges with online learning that stemmed from the content of the course, technical difficulties, and the nature of the assignments (5, 6, 11). Students typically swayed away from taking online courses due to previous negative experiences such as an unprecedented workload, increased student involvement (11, 12), lack of interaction with peers, lack of professor presence, malfunctioning electronic devices (5, 6), and difficulties with self-teaching and time management (5, 11). The above challenges may have cause of students to underperform in online courses and contributed to low retention rates (5, 11). Another challenge for online learning was the difference in student and teacher expectations which led to confusing and dissatisfying course outcomes (11). Students

taking online courses expressed that instructors expected them to learn in the same manner as those in-person (11). If given a choice, most students said they prefer not to take all their courses online, and very few believed they would learn more in the online modality (5).

One study found that students typically did not use interactive learning tools (i.e., PowerPoints, video cameras) and university learning systems often due to its lack of introduction and integration in most courses (13). Yet, instructors are fundamental in promoting the acceptance and usability of integrated technology (13). For example, 18% of instructors surveyed during the pandemic used online laboratories in their STEM virtual classrooms (14). Although 35% were aware of the technology, instructors surveyed indicated the simulations did not meet their course needs (14). At CUNY, the implementation of an online lab component varied depending on access, knowledge and relevance of the technology to the course outcomes. The institution purchased various online interactive simulations from Labster for its general biology and anatomy courses; however, access to these simulations was contingent upon individual campus/department procurement. In the absence of simulations, during Fall 2020, peer observations within the Biological Sciences department revealed that several instructors resorted to extending lectures, using pictures in place of models, data interpretation, and case studies to instruct the lab portion of their biology courses. The success of online laboratory integration in this manner has yet to be evaluated.

Challenges with online learning during the pandemic are almost a mirror compared to pre-pandemic times and have been generalized into five categorical barriers: technological, individual, domestic, institutional and community (7). Studies revealed that students frequently encountered poor Internet connection, limited access to electronic devices, a lack of dedicated study space and had great difficulty balancing their learning styles with home responsibilities

(7, 8). Students in a medical college called for a halt to online learning and the ongoing semester due to difficulties transitioning from in-person to online education (7). Students considered themselves incapable of adapting to the online learning format, which varied significantly by factors such as age, gender, family income and prior experience (7, 8, 15). Students doubted the readiness of their schools' ability to transition online due to the lack of guidelines, unfair policies, and ineffective teaching practices. They believed they should promote all students given the circumstances (7).

### Student achievement in online learning before and during the pandemic

Pre-pandemic, the relationship between student achievement and learning modality has provided a series of mixed and inconsistent results. For example, some studies show student achievement in the online learning modality was better than the in-person modality (16, 17), while others depict the opposite (18). Also noted was a disparity in grade distribution leading to grade inflations in online courses (16). Despite conflicting results, some studies showed no significant difference between the learning modalities and student achievement (19, 20). Studies conducted during the pandemic continue to depict mixed results when investigating students' achievements in the online learning modality. Studies showed a higher number of students receiving higher grades in online courses (9), grade inflations (21), and students were more successful when enrolled in in-person learning (10). Albeit the mixed results between online and in-person learning modalities on student achievement before and during the pandemic, this study hypothesized that students would rate online learning and online STEM courses more negatively than in-person. We also sort to determine whether there is a negative correlation between grades and perceptions of the online modality.

## METHODS AND STUDY DESIGN

### Participants and procedure

At the request of researchers, Vice Presidents of Student Success administered invitations to participate in the CUNY IRB-approved study (#2020-0521) via email to students who took courses at CUNY during the Spring 2020 semester at respective campuses. Five hundred and sixty-two respondents consented to participate in the online survey. We eliminated 121 respondents due to ineligibility for not taking a course in Spring 2020, duplicates, and incomplete entries; 441 eligible respondents participated in 6 days from August 1 to August 6. Students were recruited from 21 of the 23 CUNY campuses and ranged from Freshmen to Ph.D. candidates. The Authors decided to collect data from all majors despite education level as the pandemic impacted all CUNY

enrollees. The survey, comprised of 18 questions generated by the researchers (see Appendix A), was uploaded to GoogleForms.com. The anonymous survey included open-ended and Likert-scaled questions focusing on students' experiences transitioning from in-person instruction to online and their grades before and during the pandemic.

### Data analysis

Using the Statistical Package for Social Sciences (SPSS), a set of paired *t*-tests were performed to analyze student perceptions and grade outcomes by STEM versus non-STEM course types, online and in-person learning modalities, and between grades and student perceptions of online learning by course types respectively. In addition, a Pearson's correlation was performed between STEM and non-STEM majors by grades and student preferences for learning modalities and self-rated success.

## RESULTS

Table 1 demonstrates the demographics of study participants by frequency. In short, 75% of respondents identified as female. In addition, 52% experienced an increased GPA, 72% of courses taken during the Spring 2020 semester were non-STEM, 69% of respondents' first language was English, 77% were STEM majors, and 69% did not take an online course before the Spring semester.

Table 2 depicts the descriptive statistics of students' perception of their grade outcomes. The average grade for the respondents was 4.40, which translates to a B at a standard deviation of 1.05. The self-rated category revealed students perceived their level of success in the online environment as a 3.96, neutral yet leaning toward the positive scale at a standard deviation of 1.04. Students rated their ability to learn better in the online learning environment at a mean of 2.97, worst but leaning toward the neutral scale, at a standard deviation of 1.15. On average, students' ability to learn better in the in-person environment rated their success at 3.86, which translates to neutral leaning toward the better scale, at a standard deviation of 0.99.

Table 3 is an independent *t*-test for self-reported data by course type to include courses identified as STEM versus non-STEM in this study. The *P*-value in the relationship between course type and grades is .000. Since this value is less than 0.05, we can infer a statistically significant difference between the means of STEM and non-STEM courses and the respective grades. Since our *t*-test analysis revealed that the average grade for STEM courses is 4.49 (B–) and non-STEM courses are 4.68 (B), we can infer that students had slightly higher grades for non-STEM courses.

Table 4 demonstrates a paired samples *t*-test comparing the online and in-person learning modalities. The *P*-value between online and in-person courses' is 0.000, less than 0.05. Therefore, we can infer a statistical difference between

TABLE 1
Demographics of study participants[a]

| Characteristics | Frequency | |
|---|---|---|
| | *n* | % |
| Gender | | |
|    Male | 108 | 24.5 |
|    Female | 330 | 74.8 |
|    Other | 3 | 0.7 |
| GPA | | |
|    Increased | 228 | 51.7 |
|    Decreased | 77 | 17.5 |
|    Remained the same | 137 | 31.1 |
| Courses taken by students | | |
|    STEM | 341 | 27.7 |
|    Non-STEM | 884 | 71.9 |
|    Missing | 5 | 0.4 |
| Race/ethnicity | | |
|    Hispanic | 163 | 37.0 |
|    African American | 129 | 29.3 |
|    Asian | 48 | 10.9 |
|    American Indian or Alaska Native | 4 | 0.9 |
|    White | 74 | 16.8 |
|    Mixed | 7 | 1.6 |
|    Middle Eastern | 8 | 1.8 |
|    Other[b] | 6 | 1.4 |
| First language | | |
|    English | 299 | 68.0 |
|    Spanish | 68 | 15.5 |
|    Other[c] | 73 | 16.6 |
| Total household income | | |
|    <$10,000 | 78 | 17.7 |
|    $10,000–44,999 | 222 | 50.3 |
|    $45,000–74,999 | 77 | 17.5 |
|    $75,000–100,000+ | 64 | 14.5 |
| Education level | | |
|    Freshman | 99 | 22.4 |
|    Sophomore | 132 | 29.9 |
|    Junior | 73 | 16.6 |
|    Senior | 83 | 18.8 |
|    Graduate level[d] | 52 | 11.8 |
| Major type | | |
|    STEM | 341 | 77.3 |
|    Non-STEM | 65 | 14.7 |
|    Undeclared | 27 | 6.1 |
|    Dual degree | 5 | 1.1 |
|    Non-degree | 3 | 0.7 |

| Characteristics | Frequency | |
|---|---|---|
| | *n* | % |
| Previous experience with online courses? | | |
|    No | 302 | 68.5 |
|    Yes | 139 | 31.5 |

[a]N is the number of students in the study. N = 441.
[b]The "Other" category within Race/Ethnicity represents students who did not select one of the eight racial groups but wrote in Jamaican, Afro-Latinx, Caribbean, Indo-Caribbean, and European.
[c]The "Other" category within First Language represents students whose primary language was not a part of the majority, such as Cantonese, Russian, Azerbaijan, etc.
[d]Graduate level included both master's and Ph.D. students.

online and in-person preferences. Furthermore, since the average in-person rating was higher than online, we can conclude students preferred the in-person modality.

Table 5 displays the output of a paired samples *t*-test comparing students' actual grades in their STEM course with their perception of online learning for STEM courses. The *P*-value between grades and rating of success is .000. Since this value is less than 0.05, we can infer a statistically significant difference between grades and rated success in STEM courses.

Table 6 depicts the output of a paired samples *t*-test comparing students' actual grades in their non-STEM course with their perception of online learning for non-STEM classes. The *P*-value between grades and rating of success is .000. Since this value is less than 0.05, we can infer a statistically significant difference between the grades and rated success in non-STEM courses. The *P*-value between grades and the rating of online classes is .000. Again, since the *P*-value is less than 0.05, we can infer a statistically significant difference between grades and the rating of online courses in non-STEM courses.

TABLE 2
Descriptive statistics on student perceptions and grade outcomes across all courses taken during the Spring 2020 semester[a]

| Variable | N | M | SD |
|---|---|---|---|
| Grades | 441 | 4.40 | 1.05 |
| Self-rated success | 441 | 3.96 | 1.04 |
| Online learning rating | 441 | 2.97 | 1.15 |
| In-person learning rating | 441 | 3.86 | 0.99 |

[a]The grade category, calculated by converting the CUNY grading scheme from alpha to numeric, where A = 5, B = 4, C = 3, D = 2, F = 1. The self-rated success category on a 5-point Likert scale where 1 = *very poor* and 5 = *very good*. The preference for learning modalities (online and in-person) on a 5-point Likert scale where 1 = *much worse* and 5 = *much better*.

TABLE 3
Independent samples *t*-test for student perceptions and grade outcomes by STEM and non-STEM course type[a]

|  | STEM | | | Non-STEM | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | ***N*** | ***M*** | ***SD*** | ***N*** | ***M*** | ***SD*** | ***t*** | **Sig.** |
| Grades | 290 | 4.49 | 0.640 | 812 | 4.68 | 0.570 | −4.689 | 0.000[***] |
| Rated success | 328 | 3.62 | 1.39 | 823 | 4.11 | 1.17 | −6.145 | 0.000[***] |
| In-person course rating | 327 | 3.87 | 1.11 | 816 | 3.83 | 1.08 | 0.488 | 0.487 |
| Online course rating | 327 | 2.83 | 1.30 | 815 | 2.98 | 1.250 | −1.699 | 0.030[*] |

[a]*t* is the *t*-test result, and Sig. represents the *p*-value. The grade category converted the CUNY grading scheme from alpha to numeric where A = 5, B = 4, C = 3, D = 2, F = 1. In addition, the self-rated success category and preference for learning modalities were rated on a 5-point Likert scale. The self-rated success scale identified 1 = *very poor* and 5 = *very good*. The preferences for online and in-person learning modalities scale identified 1 = *much worse* and 5 = *much better*. Courses categorized as STEM included biology, physics, mathematics, etc. Non-STEM courses included those such as psychology, sociology, communication, etc. For a complete list of courses categorized as STEM versus non-STEM, see Appendix B.
[***]*P* < 0.001, [*]*P* <.05.

Table 7 is a Pearson's correlation examining the relationship between STEM and non-STEM course grades and students' preferences for either online or in-person teaching modalities. The correlation revealed a moderate positive relation between grades and rated success (*r* = *0.547*) for the STEM category, at a *P* = 0.000, however there was a very weak relationship between grades and perception of online learning (*r* = 0.238) at a *P* = .000. A weak correlation exists between grades and rated success (*r* = 0.404) in non-STEM courses, at a *P* = 0.000 and a very weak correlation between grades and perception of online learning (*r* = 0.144) at a *P* = 0.000.

## DISCUSSION

The current study found significant differences in preference, perception, and academic achievement between online and in-person courses during the Spring 2020 semester. First, preference ratings for in-person classes were higher than online courses, supporting Summers et al. and contradicting Jahng et al.'s findings (See Table 4) (19, 21). More specifically, when delving into the perceptual differences between course types, non-STEM courses were rated slightly more favorably than STEM courses. It's important to note; previous research

included participants who voluntarily enrolled in online classes (19). This study's participants were mandated into online learning for STEM and non-STEM courses due to the ongoing pandemic. The differences in the study populations and current events may have contributed to this study's aberrant findings. There may be evidence suggesting preference and experience for online courses differ when students choose to learn online. Secondly, the perception of online non-STEM courses had a slightly higher yet favorable rating than online STEM courses supporting Jaggars et al.'s findings (See Table 3) (5).

Finally, participants in this study indicated that they earned higher letter grades in online non-STEM courses than their online STEM courses supporting Faulconer et al. and Dell et al. findings, albeit factoring in the possibility for grade inflation (See Table 3) (16, 17). Further, the trend for cumulative GPA increased for 52% of respondents (See Table 1). We expected that if students had negative experiences and perceptions of a learning modality, then unsatisfactory grades for the respective course would follow, yielding a solid positive relationship between grades and perception. Instead, there was a moderate positive correlation between grades and rated success, yet there was a very weak correlation between grades and perception of online learning (See Table 7). For non-STEM courses, our study found a weak

TABLE 4
Paired samples *t*-test between online and in-person learning modality ratings

|  |  |  |  |  |  | 95% confidence interval | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Learning** | ***N*** | ***M*** | ***SD*** | ***MD***[a] | **Sig. (2-tailed)** | **Lower** | **Upper** | ***t*** | ***df*** |
| Online | 1145 | 2.93 | 1.99 | −0.908 | 0.000[***] | −1.023 | −0.793 | 15.47 | 1144 |
| In-person | 1145 | 3.84 | | | | | | | |

[a]MD, mean difference.
[***]*P* <.001.

TABLE 5
Paired samples *t*-test between grades and student perceptions of online learning for STEM courses

| Perceptual factors | N | M | SD | MD[a] | Sig. (2-tailed) | 95% confidence interval | | t | df |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper | | |
| Rated success | 327 | 3.61 | 1.39 | .06 | .000*** | −.923 | −.631 | −10.45 | 326 |
| Rating of online courses | 327 | 2.83 | 1.30 | .063 | .000*** | | | | |

[a]MD, mean difference.
***$P < .001$.

correlation between grades and rated success and a very weak correlation between grades and perception of online learning (See Table 7). With these findings, we can conclude that the trend of grades is not congruent with students' perception of online learning, rated success, and perception of the modality. Therefore, this study's third hypothesis would be accepted. Our findings conclude that a disconnect exists between students' achievement and their perception of learning modality.

### Limitations and future research

The authors identified several limitations in this study. The survey was administered via google forms and was anonymous. Anonymity did not allow researchers to follow up on participants' responses. The limit with the anonymous surveys also includes the potential for students to answer questions dishonestly, not answering questions thoroughly, and difficulty converting one's emotions to a Likert scale. Another limitation was the respondents' input of grades for courses was inconsistent; some students entered numerical values while others entered letter grades. The inconsistency with grade entries resulted in recategorizing the numeric grades into standard CUNY letter grades. Although the survey included a disqualification section to eliminate those who weren't eligible to participate in the study, there exists the potential of respondents overriding the system in the effort to record a response. Finally, we identified several biases among the study participants, including 75% of respondents identified as female, 72% of courses taken during the Spring 2020 semester were non-STEM classes, and 77% of the participants identified as STEM majors. Confounding variables may have existed and impacted the perceptions of online learning during the pandemic to include but are not limited to illness from COVID-19,

experiencing death among family members, income uncertainties, and the undesired shift to remote learning.

It would be helpful to include the qualitative data collected regarding each course's favorable and unfavorable aspects in future studies. In addition, future studies should consist of more educational institutions and instructors to better understand how online courses are experienced on a broader scale to include the teaching and learning perspective. Finally, researchers should revise the survey questions to unpack the perception of mastery in each class compared to the modality differences in student learning.

### Conclusion

The findings from this research implied that institutions with forced online learning modalities consider student preferences for in-person learning and modify online learning to address student preferences. It also suggested that students majoring in or taking liberal arts courses in the STEM field would rather be in-person. Institutions may freely consider moving non-STEM classes online during a pandemic. However, for classes that require a hands-on lab component, institutions may want to consider keeping those courses in-person but ensure physical distancing and other safety measures are in place to reduce the spread of the virus. A lack of technical savviness is a barrier to the teaching and learning process. It may serve as a best practices approach to train faculty and students on using technology in online learning courses before starting the semester or at the onset. Finally, the findings found a split in preference for students being self-taught; therefore, the study implied that instructors might consider remaining engaged synchronously in helping students navigate the online learning modality and reduce the feeling that they are on their own.

TABLE 6
Paired samples *t*-test between grades and student perceptions of online learning for non-STEM courses

| Perceptual factors | N | M | SD | MD[a] | Sig. (2-tailed) | 95% confidence interval | | t | df |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper | | |
| Rated success | 819 | 4.10 | 1.18 | 0.169 | 0.000*** | 1.047 | 1.219 | 26.019 | 818 |
| Rating of online courses | 819 | 2.97 | 1.25 | 1.330 | 0.000*** | | | | |

[a]MD, mean difference.
***$P < 0.001$.

TABLE 7
Pearson correlations among STEM and non-STEM majors by grades and student preferences for online or in-person learning modalities

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Consolidated (STEM & Non-STEM) | | | | |
| 1. Grades | | | | |
| 2. Online preference | 0.181[b] | | | |
| 3. In-person preference | −0.071[a] | −0.439[b] | | |
| 4. Rated success | 0.466[b] | 0.449[b] | −0.159[b] | |
| STEM | | | | |
| 1. Grades | | | | |
| 2. Online preference | 0.238[b] | | | |
| 3. In-person preference | −0.092 | −0.432[b] | | |
| 4. Rated success | 0.547[b] | 0.493[b] | −0.147[b] | |
| Non-STEM | | | | |
| 1. Grades | | | | |
| 2. Online preference | 0.144[b] | | | |
| 3. In-person preference | −0.056 | −0.439[b] | | |
| 4. Rated success | 0.404[b] | 0.422[b] | −0.159[b] | |

[a]Correlation is significant at the $P < 0.05$ level (1-tailed).
[b]Correlation is significant at the 0.000 level (1-tailed).

## SUPPLEMENTAL MATERIAL

Supplemental material is available online only.

**SUPPLEMENTAL FILE 1**, PDF file, 0.1 MB.

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