

Impact of Online Learning in the Context of COVID-19 on Undergraduates with Disabilities and Mental Health Concerns

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The COVID-19 pandemic upended college education and the experiences of students due to the rapid and uneven shift to online learning. This study examined the experiences of students with disabilities with online learning, with a consideration of surrounding stressors such as financial pressures. In a mixed method approach, we compared 28 undergraduate students with disabilities (including mental health concerns) to their peers during 2020, to assess differences and similarities in their educational concerns, stress levels and COVID-19 related adversities. We found that students with disabilities entered the Spring quarter of 2020 with significantly higher concerns about classes going online, and reported more recent negative life events than other students. These differences between the two groups diminished three months later with the exception of recent negative life events. For a fuller understanding of students' experiences, we conducted qualitative analysis of open ended interviews. We examined both positive and negative experiences with online learning among students with disabilities and mental health concerns. We describe how online learning enabled greater access—e.g., reducing the need for travel to campus—alongside ways in which online learning impeded academic engagement—e.g., reducing interpersonal interaction. We highlight a need for learning systems to meet the diverse and dynamic needs of students with disabilities.

CCS Concepts: • **Human-centered computing** → **Empirical studies in accessibility**.

Additional Key Words and Phrases: disability, education, mental health, COVID-19, mixed methods, hybrid learning systems

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1 INTRODUCTION

The impact of the COVID-19 pandemic on students in general continues to be large: worries about physical health, ongoing changes in educational delivery methods, and increased isolation are all factors that can affect students [67]. Financial burdens due to the need for accessible housing and personal assistance [49, 50], less money overall [13], and greater health risks serves to increase the stress and distress students with disabilities and mental health concerns experience [9, 73]. In addition, the risk to their education is higher due to potential accessibility barriers that may

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worsen as course content and classroom environments are striving to adapt, alongside increased stress levels that can compromise learning [32, 55].

Information about the impact of COVID-19, during the shift online, on students with disabilities can help to improve our understanding of the educational challenges and opportunities faced by students as we unsteadily transition back to in-person (or hybrid) education. However, although studies have explored the impact of COVID-19 on students with mental health concerns (e.g., [24, 75]) and disabilities (e.g., [35]), there remains a dearth of information that considers this in the context of higher education accessibility, and that includes both survey data at scale and interview data, as well as comparisons to students without disabilities and mental health concerns.

1.1 Terminology

In this article, we use the term *students with disabilities/mental health concerns*, which we define broadly to include people who use disability resources and/or self-identify as disabled; and those with mental health concerns who may or may not identify as disabled [57, 61]. We use a modified version of Ringland’s inclusion criteria to identify this latter group [57], namely a combination of mental health scales and use of mental health resources. Taken together, we believe this encompasses the most common disabilities reported by college students [22, 56, 77], though under-reporting complicates assessment of this [10, 56].

1.2 Contributions

In March and June of 2020 (which we refer to as *pre-term* and *post-term*, respectively), we surveyed and interviewed undergraduate students drawn from the general population to understand their experiences during the pandemic, including their psychological well-being, loneliness, home life, and experiences with remote learning as part of a multi-year study at a large public university. Initial findings from that study were summarized in a previous paper [42]. In the current article, we draw from that data and additional interview data focused on students with disabilities/mental health concerns to investigate the COVID-19 experience from a disability and mental health concern perspective. Using a mixed-method approach, we aim to more fully capture how the COVID-19 pandemic affected the education of students with disabilities/mental health concerns after the onset of online learning, as well as identify other areas of adversity for students. Our contributions are the following:

Survey findings. Our survey study suggests that when the shift to online instruction was initially announced, students with disabilities/mental health concerns had greater concerns about classes going online compared to students without, particularly the impact on their degree goals, such as admission to a desired major, and graduation timing. However, after a quarter of online learning, both students with and without disabilities/mental health concerns were much less concerned about their education than before, though differences in concerns about grades, moving degree requirements, admission to major, and financial aid, remain. In addition, students with disabilities/mental health concerns reported more stress exposure, and more adverse events, than those without, though this improved somewhat over the quarter.

Interview findings. Interviews highlighted the ways in which online learning helped and hindered students with disabilities/mental health concerns. Access was increased by recorded lectures that could be watched at different times and speeds, online office hours, and chat features for asking questions during lectures. At the same time, the lack of interactivity decreased academic engagement and intensified mental health concerns. The strains of online learning for

students with disabilities/mental health concerns were entwined with financial disparities as well as pandemic related concerns.

This article provides an important snapshot of online educational experiences among students with and without disabilities/mental health concerns. Some of our results are unique to students with disabilities, such as the accessibility impact of newly available accommodations (such as recorded lectures), the automatic provision of accommodations that previously required formal requests, and reduced stressors such as fatigue due to availability of online office hours and classes which reduced cross-campus or commuting travel. Other results apply to both populations, including difficulties with attention during lectures, and increased challenges connecting with peers [42].

Overall, we believe that our data highlight the accessibility benefits of an emergent generation of pedagogy that extends beyond the pandemic to support *flexible learning approaches* that can meet the varying needs of students, whether those are best met in person or at home. Our data demonstrate accessibility reasons for these changes, and helps to document strong evidence supporting not only a moral but also a legal case [21] for flexible learning approaches. Yet, even in the midst of the pandemic such requests are routinely denied (e.g. [20, 30, 72]) and people with disabilities are especially vulnerable. As an additional benefit, many students without disabilities, who do not identify as disabled, or who have other needs (such as caregiving obligations) can also gain increased educational access with this new approach to learning.

Our work also provides motivation for the importance of improving the accessibility of online classes, and relatedly, the ease with which instructors can make such classes accessible. In addition, as Ringland *et al.* (2019) argue, accessibility solutions must take a holistic, contextualized view of the person. Among our participants, this means including multiple aspects of identity as well as potential stresses and concerns. Thus, we argue that during the COVID-19 pandemic, and in general, an accessible education is also one that contributes to student well-being and resilience.

1.3 Positionality of the authors

The complex issues raised in this article represent perspectives with which the authors themselves are deeply entwined, and given the reflexive nature of qualitative work [58], we note here that the authors of this article included a clinical psychologist, an author who identifies as disabled, authors who have past histories using campus resources for both disability and mental health needs; two Asian authors who lived in the U.S. as students both before and after the onset of the COVID-19 pandemic; an author who is responsible for the education of a disabled child who required online education in 2020/21 to participate in school, and an author with a child with developmental delays needing special supports.

2 RELATED WORK

Life as an undergraduate student presents an exciting and challenging opportunity to learn, innovate, and grow. However, exposure to stress is also common among college students [3]. In addition, some stressors (such as discriminatory behavior [63]) differentially impact vulnerable groups, particularly when these interact with risk or challenge of a students' security [62]. Increasing participation by people with disabilities requires understanding and efforts to lessen the particular stressors and risks they face. During the period of this study, the COVID-19 pandemic is one obvious stressor that may directly impact students in a multitude of ways. Some may be at greater risk of contracting the illness and experiencing interrupted access to health services [4]. Pandemics can also impact the availability of personal assistance, reduce educational accessibility [32], and create higher risks when exposed to infection for people with

disabilities than for the overall population [16, 52]. Below we explore expected consequences of these stressors for learning and mental health among people with disabilities/mental health concerns.

2.1 Disability and Mental Health in Higher Education

Statistics on disability among college students can be difficult to locate and interpret for two reasons. First, many people who may qualify as disabled do not have a disability identity, or choose not to disclose their disability to postsecondary institutions [22]. Second, disability statistics are either not collected at all, or are not collected in a uniform manner [11]. Despite these challenges, it remains important to understand the relative prevalence of different disabilities in student populations. According to multiple sources, learning disabilities, ADHD, mental health, and chronic illness or other health impairments are the top four disabilities reported by college students [19, 22, 38, 56].

Multiple sources suggest that about half of college students have one or more of these disabilities and/or chronic conditions [10, 22, 38, 56] though few students accessing treatment also access campus disability service offices [22]. For example, one report estimates that among students with disabilities, the largest group is students with learning disabilities [38]. However, the National Center for Learning Disabilities reported in 2014 that only 17% of college students with learning disabilities take advantage of learning assistance resources at their school, compared to 94% of high school students with learning disabilities who receive some form of assistance [19]. Similarly, mental health is under-reported as a disability: almost 30% of college students endorse being diagnosed or treated by professional for a mental health disorder (predominately depression and anxiety) in the past year [5, 12], suggesting symptomatology sufficiently significant to cause impairment or benefit from accessibility services.

People with disabilities of working age are more likely to live in poverty [13]; and half as many attend a 4-year colleges than their non-disabled peers [65]. In addition, students with disabilities are more likely to delay the start of their higher education degree and take about twice as long to complete the degree, and are more likely to leave without completing it than their non-disabled peers [33, 51, 77]. The relative impact of structural barriers such as inaccessible application processes, courses and campuses over individual difficulties, is not yet clearly delineated in prior work, in part because it is extremely difficult to study higher education without such structural barriers. If the changes caused by the onset of COVID-19 increase accessibility for long enough, this could represent a natural experiment that may shed light on the impact of structural barriers.

2.2 The Impact of COVID-19 on Disability and Mental Health

People with disabilities may be at risk of worse reactions to the COVID-19 pandemic. In addition, emergency response plans do not always include planning for people with disabilities [16]; social distancing may be harder for people with disabilities who rely on caregivers; and people with disabilities may have to deal with inaccessible communications [16]. These risks serve to put people with disabilities at greater risk of experiencing distress associated with the pandemic. Their concerns about personal safety may be stronger than those of people without disabilities and they may be more vulnerable to stressors during the pandemic (such as disruption of critical health care). For these reasons they are at greater risk of distress.

Students with mental health concerns also face increased risks. Even before the pandemic, universities were seeing high and growing levels of mental health struggles among students [34]. Further, natural disasters as well as past epidemics such as SARS, have been associated with psychological distress, depression and substance abuse [26, 28, 36, 45, 74]. Adverse psychological effects of the current pandemic can be serious, but are not proving to be uniform [54]. For example, many individuals show resilience in disasters; this resilience manifested in a recent study of college

students who, contrary to expectations, reported less loneliness in April than in February of 2020 [23]. Daily surveys by Kanter *et al.* (2020) of the general population during the COVID-19 pandemic have not shown overall increases in anxiety, depression or loneliness. On the other hand, a group of researchers at Dartmouth College observed that the public-health crisis has worsened the mental health of college students [29, 39]. Similarly, Wang *et al.* and Fruehwirth *et al.* also found that the pandemic elevated the anxiety and depression levels of college students [24, 75]. In addition, students with a history of stress exposure have elevated allostatic load which refers to dysregulation across a range of physiological systems as a function of stress and negative life events [40], lessening their physiological capacity for resilience to the additional demands brought on by the pandemic.

2.3 The Impact of the COVID-19 pandemic on Education Accessibility

One significant impact of the COVID-19 pandemic has been the shift to online learning, often with instructors for whom this was new. This made for a mixed picture. For some, online learning has become more common over the last decade [53], and even before the radical changes imposed by social distancing in the era of the COVID-19 pandemic, issues existed with the accessibility of online courses [59]. In addition, although colleges are required by law to provide accommodations for students with disabilities, students must request those accommodations from an office of disability resources for students (DRS). The disability must be documented in order to receive these accommodations. This is a difficult process for students with disabilities and may potentially hinder them from requesting accommodations [11]. When faculty additionally have to make rapid changes to their courses due to pressure to go online quickly, it is even less likely that they will make time to attend to an issue they are unsure of, like accessibility [15]. Reflecting on remote learning after the outbreak of the COVID-19 pandemic, Byers *et al.* (2021) highlight a “steep learning [curve] and need for sighted support,” even when using technologies that are deemed accessible.

Although course content accessibility has been studied, this provides only a partial view of how online learning might impact students with disabilities. For example, one study of websites describing disability services found room for improvement in graduate student support, emphasizing the value of flexibility when compared with medical models requiring physician documentation, and the need to reduce ableism that students encountered [71]. This points to the need for a holistic approach to understanding disabled students’ experiences regarding accessibility that can tease apart the pros and cons of online learning. For example, even if course content is less accessible, a shift to online learning may be, at least temporarily, reducing the need for disability disclosure, increasing flexibility if instructors are being especially accommodating because of the pandemic, or reducing barriers for students with mobility-related impairments.

2.4 Previous Findings on Heterogeneous Experiences During the Pandemic

In a previous study on student experiences with online learning during the pandemic, no differences in well-being were observed between 2019 and 2020 when comparing full sample averages, but heterogeneity across students was evident ([42]). This heterogeneity suggests the value of characterizing individual experiences through qualitative interviews. Findings from interviews with students from that general sample were reported ([42]), but that analysis did not focus on disabilities. The present analysis addresses this gap, providing a contextualized illustration of negative and positive impacts of online learning in this population.

2.5 Summary and Research Goals

This article addresses time-sensitive questions regarding the adversity profiles and well-being of university students during the current pandemic, with particular focuses on those with disabilities/mental health concerns. To do so, we leverage data from a large ongoing study described in previous work [63]. In addition, we analyze interview data specifically collected for this study and re-analyze our quantitative data focusing on participants with disabilities, from a disability perspective. Our analysis focuses specifically on the experiences and accessibility concerns of students with disabilities/mental health concerns in 2020.

Drawing from research related to cumulative disadvantage and marginality [47], we anticipate that students with disabilities/mental health concerns will express justifiably greater vulnerability in the COVID-19 context through elevated levels of concern about their educational environment and likelihood of success, as well as features of their family and personal lives affected by the pandemic.

Finally, we anticipate that students with disabilities/mental health concerns may be experiencing greater adversity exposure and associated levels of stress. Below, we describe our use of a combination of quantitative (3.1) and qualitative (3.2) methods responsive to our research questions.

3 METHODS

This article draws data and participants from a larger survey study of stress and well-being among undergraduate college students that has been ongoing since 2018 [63]. Students recruited in 2018 were first-year college students. They were encouraged to continue throughout the study, with new students being added each year. While the study enrolls a broad sample of students, its design intentionally over-samples students with identities that might be vulnerable, including students with disabilities/mental health concerns, students with under-represented minority status, low income students, and first-generation students. Students are paid to participate in the study, which is IRB approved. Our quantitative analysis considers here survey data collected in March (*pre-term* survey) and June (*post-term* survey) during COVID-19 in 2020.

3.1 Survey

Students were asked for demographic data including their self-reported disability status. In the *pre-term* and *post-term* surveys, students were asked to complete an hour-long questionnaire consisting of a series of well-established scales to measure chronic discrimination and harassment (CEDH [41]); major life events (MLE [48]); perceived stress (PSS [18]); loneliness (UCLA [60]); and perceived social status (SES [1]). In addition, we used a post-traumatic stress disorder scale (PCL-5 [76]). Because this scale is only validated as a measure of PTSD when a diagnosis is present, and the questions themselves focus on stress, distress, and their consequences, we refer to this measure as PCL-5 (distress). Two scales (Spring Online Class Concerns/Stress and COVID-19 Related Adversity) listed in Table 5 (in Appendix) were also included in our questionnaire to examine adversities directly related to COVID-19 pandemic. Several of these scales asked students to reflect over a period of time. The perceived stress and trauma symptomatology assessed the past month. Students reported major life events (adverse, traumatic or stressful events) in the past quarter (Winter quarter in the *pre-term* survey; Spring quarter in the *post-term* survey). Our measures of loneliness did not specify a timescale. It was thus likely that answers to the loneliness scale include current status.

Starting in 2020, a few weeks after the start of the COVID-19 pandemic, courses went online approximately two weeks before the end of the Winter quarter (early March 2020). Students were asked to fill out the *pre-term* survey to

assess the immediate reactions to the onset of the COVID-19 pandemic among students with disabilities/mental health concerns compared to their peers, including a range of topics such as pre-existing conditions that could make students vulnerable to COVID-19, and concerns about classes going online. In addition, the study includes a student-specific measure of COVID-19 related adversities. The questions used in the COVID-19 related measures are shown in Table 5 (See Appendix B.2).

Spring 2020 was a period of uncertainty marked by the rapid shift to online learning and frequent changes to public health restrictions. At the end of the Spring 2020 (early June), students were asked to fill out the *post-term* survey. Our goal was to understand the differences between students with disabilities/mental health concerns and their peers, before and after a whole quarter of online learning and staying at home. The timeline of data collection and its relationship to COVID-19 is shown in Table 4 (See Appendix A).

Data from 2019 and 2020 were analyzed in [42], however no disability specific analysis was completed. The current article explores data from 2020 and specifically compares students with and without disabilities.

3.1.1 Survey Participants. We assigned students' disability status primarily based on self-identification, while mental health concerns were identified based on a combination of scales from the *pre-term* and *post-term* surveys. Students were categorized as having mental health concerns if they reported *moderate* or *severe* depression¹ (BDI2 [6]) and *severe* anxiety² (STAI [68]) and used mental health resources (*e.g.*, university mental health counseling) within the past year. Our criteria for identifying students with mental health concerns are consistent with classification systems and service provision contexts [37, 66]. Based on our analysis of background literature, such students will likely not identify as disabled, despite facing access issues and experiencing accessibility needs that may overlap with those of self-identified disabled students [56].

Our 2020 survey data included 147 students, of which five were excluded from the quantitative analysis due to missing data. Among the 142 students, 81 (57%) were Engineering students, 44 (31%) were Arts & Sciences students, while 17 (12%) students were from other majors. In addition, 65 (46%), 49 (34%), and 28 (20%) students were first-, second- and third-year students, respectively. Of the total sample, 28 were students with disabilities/mental health concerns. Note that students could indicate multiple types of disability and that five students who self-identified as disabled also met the criteria of mental health concerns. Table 1 shows the demographics of students in the study.

In March 2020, participants completed the *pre-term* survey after their last Winter quarter final. At that time, the university had been teaching online for at least two weeks, and students knew that half or more of Spring quarter would be online. The majority (80%) of students completed it between March 18 and March 29. At the time, social distancing restrictions were increasing city and state-wide. The initial stay-at-home order in the state where the university is located was issued March 23rd. In June, students were instructed to complete the *post-term* survey after their last Spring quarter final. Nearly all (93%) students completed it between June 7 and June 14. The full timeline of announcements and events of relevance is shown in Table 4 (see Appendix A).

3.1.2 Survey Analytic Approach. Data were cleaned and scales were calculated as part of the standard study procedures used in the larger study (see [63] for more details). Quantitative analysis was guided by the research questions, including full sample portrayals of variable distributions as well as between-group tests of difference (between students with and without disabilities/mental health concerns). When our data were not normally distributed we ran

¹In BDI2, a total score of 20-28 is considered moderate depression and 29-63 is severe.

²In STAI, a total score of 45-80 is considered severe anxiety.

Table 1. Demographics. Race-based URM stands for under-represented minority (African-American, Latinx, Native American, and Pacific Islander); FirstGen stands for First Generation College students. COVID-19 health vulnerability includes students who self-identified as having a pre-existing condition that put them at risk for COVID-19. CUMGPA stands for cumulative GPA of that year. We mark this as N/A for interviews because two interviewees did not provide data on COVID-19 health vulnerability.

Demographics	Quantitative analysis		Interviews
	D/MH (n=28)	No D/MH (n=114)	D/MH (n=10)
% Female	25 (89.3%)	54 (47.4%)	7 (70%)
% Asian	16 (57.1%)	65 (57.0%)	6 (60%)
% White	7 (25.0%)	32 (28.0%)	2 (20%)
% Black	0 (0%)	2 (1.8%)	0 (0%)
% Race-based URM	3 (10.7%)	12 (10.5%)	2 (20%)
% FirstGen	9 (32.1%)	40 (35.1%)	4 (40%)
% LGBTQIA+	8 (28.6%)	15 (13.2%)	2 (20%)
% COVID-19 health vulnerability	5 (17.9%)	4 (3.5%)	N/A
Average SES	5.5	5.8	4.9
Average CUMGPA	3.43	3.51	3.26
Mental Health Concern	22 (78.6%)		8 (80%)
Vision or hearing impairment	10 (35.7%)		1 (10%)
Learning disability	1 (3.6%)		2 (20%)
Other disability or impairment	1 (3.6%)		1 (10%)
Self-identified disabled	19 (67.9%)		7 (70%)

Mann-Whitney U tests (non-parametric) for more conservative significance testing. To address Type-I error rate in multiple comparisons, we used the Benjamini-Hochberg (B-H) method [7, 8].

3.2 Interviews

Semi-structured individual interviews addressed experiences with remote education and psychosocial well-being during the pandemic. The twenty-seven initial interviews with a general sample, summarized by Morris *et al.* [42], were conducted from June 8 to June 24, 2020. An additional four interviews were conducted from March 9 to April 5, 2021. These follow up interviews were exclusively with students with disabilities/mental health concerns and are new to this article.

Interviews were all conducted over Zoom by one or two researchers, and all followed a 90 minute, semi-structured protocol. Participants were asked about a wide variety of aspects of remote education from online classes to study sessions to office hours. Participants discussed technological and social barriers to learning. Participants also were asked about their living situation and how that impacted their education, communication with others and their support networks. Each participant received a \$40 Amazon gift card for their participation in the interview. Interviews were recorded and transcribed. An interview guide is included in Appendix B.2.

3.2.1 Interview Participants. We draw on two sets of participants for the current analysis. First are six participants who were drawn from the 27 participants interviewed in June of 2020 [42]. These six were selected because they met the criteria for disabilities/mental health concerns defined in section 1.1. The data from those students were re-analyzed from an accessibility perspective. To enlarge our sample, we recruited another set of 25 participants who met the same criteria. Four of these 25 students participated in interviews in March/April of 2021. As a supplement to Table 1, Table 2 details each participant’s disability status. To preserve privacy, we do not specify ethnicity or preferred pronouns in the table, but summarize them in the caption. For similar reasons, we use they/them pronouns

when referring to participants in the results section. Five interviewees were Asian; two were Latina, and two were white. Three identified as male and seven as female. Participants S2021-MH-31, S2021-MH-32, S2021-ADHD-33 and S2021-VI-34 are the sample from 2021, as specified in their participant ID.

Table 2. Demographics of ten interviews. Six interviewees were Asian; two were Latina, and two were white. Three identified as male and seven as female. POTS stands for Postural Orthostatic Tachycardia Syndrome, a complex chronic condition that includes time-varying fatigue and cognitive impacts.

ID #	Primary D/MH Concern
S2020-MH-02	Depression
S2020-ADHD-06	ADHD Symptoms
S2020-POTS-09	POTS
S2020-MH-17	Depression
S2020-MH-19	Anxiety
S2020-MH-20	Depression
S2021-MH-31	Anxiety
S2021-MH-32	Depression
S2021-ADHD-33	ADHD
S2021-VI-34	Visual impairment

3.2.2 Interview Analytic Approach. As part of thematic analysis conducted for the foundational study [42], a preliminary set of codes and related themes were identified. After conducting the four additional interviews in 2021, the researchers developed and applied additional accessibility related codes. In both sets of interviews, notes and interview summaries were written and discussed prior to code development. The researchers resolved all discrepancies in coding through discussion and transcript review. The results presented in this article integrate the disabilities/mental health concerns related codes, including advantages of online learning, difficulty/additional burdens of online learning, pandemic exacerbations (examples where pandemic related issues compounded the struggles experienced by students with disabilities) and feeling unworthy of assistance.

4 RESULTS

4.1 Survey Results

We first compare students with disabilities/mental health concerns to their peers in the *pre-term* and *post-term* surveys regarding their adversity exposures directly related to the COVID-19 pandemic such as concerns about classes going online. We then examine differences in discrimination, recent major life adverse events, and loneliness.

4.1.1 Online Learning Concerns/Stress and COVID-19 Related Adversities. As shown in Table 3, students with disabilities/mental health concerns entered the Spring quarter of 2020 with significantly higher concerns about their online class experience than their peers. At the start of the term, the survey asked about how concerned students were about anticipated stressors; at the end of the end of the term, the survey asked how stressful online learning had been. As shown in Table 5 (in Appendix), differences in question wording on the two surveys reflects the change from future predictions to reflection on the past. the mean response to this prospective question in the *pre-term* survey was 2.43 compared to .91 for the retrospective question in the *post-term* survey. A Mann-Whitney test of these *pre-term* and *post-term* responses was significant ($u = 52.0, p < .001$) indicating that students' actual experience of online learning (*post-term*) was less challenging than they anticipated for the Spring quarter at *pre-term*.

Table 3. Means and standard deviations of scores on 7 measures of interest for students with disabilities/mental health concerns (D/MH) and without disabilities/mental health concerns (No D/MH) in the *pre-term* and *post-term* surveys. Mann-Whitney U test values and significance levels are indicated. Significance is marked * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. q values are the adjusted p values by Benjamini-Hochberg (B-H) method. Measures that are significant after B-H corrections are in bold.

(a) Pre-term survey							
Measure	D/MH		No D/MH		u	p value	q value
	Mean	Std	Mean	Std			
Spring Online Classes Concerns	2.43	0.71	2.07	0.76	1146.5	.011*	.015
COVID-19 Related Adversity	2.64	1.77	1.61	1.38	1061.0	.003**	.009
CEDH (Chronic Discrimination) [41]	1.54	1.4	0.87	1.4	1082.5	.002**	.004
Major Life Event (previous quarter)	4.46	3.25	3.13	1.96	1193.5	.018*	.026
PSS (stress) [18]	21.86	6.77	18.32	5.36	1054.0	.003**	.006
PCL-5 (distress) [76]	23.71	14.09	12.63	11.61	810.5	<.001***	<.001
UCLA (Loneliness) [60]	22.18	5.4	22.26	5.05	1588.0	.485	.485
(b) Post-term survey							
Measure	D/MH		No D/MH		u	p value	q value
	Mean	Std	Mean	Std			
Spring Online Classes Stress	0.91	0.7	0.95	0.75	1555.5	.418	.418
COVID-19 Related Adversity	2.29	1.76	1.58	1.41	1211.5	.022*	.076
CEDH (Chronic Discrimination) [41]	2.07	2.39	1.29	1.86	1257.5	.032*	.056
Major Life Event (previous quarter)	4.68	3.15	3.08	2.28	1057.0	.003**	.018
PSS (stress) [18]	20.18	7.52	18.11	6.25	1325.5	.093	.130
PCL-5 (distress) [76]	25.48	16.81	18.09	14.65	1141.0	.024*	.056
UCLA (Loneliness) [60]	22.5	5.46	21.94	4.92	1501.5	.315	.367

4.1.2 *Stress Exposures*. Probing on the finding of increased COVID-19 related adversities and concerns among students with disabilities reported above, we examine a variety of additional factors that might impact students' stress, mental health, and the accessibility of online learning.

In Table 3a, students with disabilities/mental health concerns reported higher levels of chronic discrimination (e.g., experiencing demeaning remarks or forms of unfair treatment), recent negative life events (e.g., a serious interpersonal conflict and/or maltreatment that occurred in the past academic ter), greater perceived stress and distress compared to those without disabilities/mental health concerns. Note that both groups of students reported comparable levels of loneliness.

As can be seen in Table 3b, after a whole quarter of online learning and staying at home, students with disabilities/mental health concerns still reported significantly more recent negative life events than their peers. The differences between the groups in COVID-19 related adversities, online classes stress, and distress between the two groups diminished. Some differences in Table 3b indicate significance via conventional testing, but not all with the more conservative Benjamini-Hochberg method. Except for a significant decrease in online classes stress, students with disabilities/mental health concerns maintained comparable levels on all other measures before and at the conclusion of the Spring quarter.

4.2 Interview Results

Our interview findings provide a contextualized illustration of struggles and benefits of online learning and the pandemic context experienced by students with disabilities. Given heterogeneity of experiences during the pandemic ([42])

qualitative analysis provides insight into contexts and impacts that are not evident in comparisons of group averages. Our findings here illustrate that the shift to online learning due to COVID-19 created both challenges and opportunities for students with disabilities/mental health concerns, paralleling findings from our previous finding with a general student sample [42]. Most participants reported that some aspects of their online learning were more accessible than their offline equivalents. At the same time, participants described ways in which online learning intensified problems with attention and mood, and added to their fatigue.

Moreover, many participants described financial stressors that constrained their access to treatments, to adequate live/work spaces, and to college itself. As previously examined, factors such as socioeconomic disadvantage and other marginalizing characteristics are often overlapping and can compound stress effects during remote education [42]. Here, we highlight needs and opportunities that are specific to students with disabilities/mental health concerns.

We make note of which findings were specific to the ten students with disabilities/mental health concerns (♿+) and which were found across the larger general sample (♿) interviewed in both 2020 and 2021.

4.2.1 ♿+♿ Online Lectures: Benefits and Barriers to Engagement. There are accessibility benefits of online lectures because they provide great flexibility in how and where students engage with class materials. For example, a student with POTS (S2020-POTS-09) found it much easier to attend classes remotely. They had fewer symptoms and less exhaustion when they did not have to physically walk around campus.

My illness prevents me from standing for a long time or walking for a long time. So for this quarter with things being online. I don't have to walk around campus from place to place. So that helped me control my symptoms and stuff. So learning has not been too bad, actually, for me... (S2020-POTS-09)

A student with a visual impairment (S2021-VI-34) described challenges and benefits with online learning. They could bring the online content physically closer to their face, so they could read it more easily but they experienced fatigue and difficulty sustaining focus after staring at a screen for long stretches. It was especially hard for them to engage in recorded lectures that contained slides dense with text and code as opposed to more discussion-oriented lectures:

Kind of in a mixed bag because, on one hand, the lecture presentations are way closer to me, so I can see the things a lot more clearly, and I can also rewind or like slow down the video and pause...like one of my computer science lectures, ...it's asynchronous and for that there isn't a lot of visual learning to it it's just typing words on a screen so, then there are a lot of times, where I just like I can't focus on this and I pause and then it's good when I take breaks, but then there's times, where I pause and then I like don't come back for hours or days even.... the biggest thing for me is just sometimes forgetting to finish the lectures because it's difficult to focus on. (S2021-VI-34)

Several students described ways in which online lectures created barriers to engagement, and in turn, intensified mental health and attentional concerns. For example, a student with ADHD (S2021-ADHD-33) talked about the difficulty of focusing without the presence of other students in a lecture hall. They were easily distracted by other screens at their desk and did not have methods for effectively blocking themselves from those distractions. During the pandemic, this student's trouble focusing became more obvious, not just to them but to the two room mates with whom he shared a small apartment where they all studied in the same room for ten hours every day. They nudged the participant to seek ADHD diagnosis and treatment. This participant's exercise and social contact were severely restricted due to fears of exposing themselves and their roommates and family to the virus. Whereas focus and exercise were concerns for

the general sample of students [42], for students with ADHD the lack of activity, outdoor time and structure appeared to exacerbate difficulty focusing in online lectures and other aspects of online learning [46].


Some students with depression said that they felt more disengaged with online learning in general, compared to in-person learning, and felt more depressed as a result of that disengagement (e.g., S2020-MH-20, S2021-MH-32). One of these participants, who was facing cuts to their financial aid, job pressures, and a tense home environment, found it much harder to focus when classes were online. They attributed this in part to not being in the same room as the professor, and not seeing their professors move as they spoke, as well as background noise in the small living space they shared with their parents. In addition, they found themselves engaging in other activities during lectures:

At first, it was kind of fun to be sitting in my kitchen. listening to my lectures because I could get up and get food whenever I wanted. But then you know, when the lectures lost my interest, it was too easy to walk away to start folding laundry or baking something. (S2020-MH-20)

Again, this experience is not unique to students with disabilities, and multiple pressures interfered with this particular student's focus. Finally, the slow pace of live lectures prevented many students from staying focused, including those with ADHD symptoms. One student with ADHD symptoms explained:

Sometimes it's hard to sit through like hours of lectures and watch it. It might just be easier to Google the equation and figure out how it works instead of listening through all of it. And so I didn't watch all of my lectures. (S2020-ADHD-06)

The mixed reactions to online learning illustrate that what is a helpful accommodation for one student can impede learning for students with other disabilities. And even for a given student, an accommodation that addresses some problems may introduce new challenges or tensions that need to be negotiated.

4.2.2  *Recorded vs. Live Lectures: Negotiating Trade-offs between Accessibility and Accountability.* Recorded lectures, offered either as an alternative to live lectures, or sometimes the sole mode of instruction, provide more flexibility by allowing students to watch lectures at different times and speeds. Prior to the COVID-19 pandemic, lectures were traditionally conducted in person. However, with the outbreak of the pandemic, institutions transited a large number of lectures from in-person to pre-recorded lectures and live video calls. The flexibility afforded by online lectures was described in accessibility terms by students with attentional problems who could not focus on a slow-moving lecture, those with visual impairments who needed to rewind and pause lectures, and those with depression who had trouble attending early morning classes.

A student with major depression appreciated that recorded lectures had become the norm during the pandemic. Recordings of early morning lectures were no longer something they had to request as an accommodation:

During COVID it's definitely been more like almost this norm for teachers to record their lectures, which has been really helpful because I didn't have to really advocate, it was already available, zoom recordings are already available. (S2021-MH-32)

Others appreciated that they could listen to recorded lectures at their convenience, and at a speed (e.g., 2x) that kept them focused. A student with ADHD symptoms found their live class much more engaging than recorded lectures but still valued the flexibility of recorded lectures:

...it's difficult to focus. And so in that case, having an online class was more helpful than a live lecture because I'm going to pause lectures and go at my own pace. I don't have to sit in a classroom for like two and a half hours without being able to leave...And so because of like the physical freedom. And

like there's no restrictions of having to be at a certain place at a certain time for like two hours. For my mental health—I feel like online classes give me more flexibility. (S2020-ADHD-06)

Similarly, a student with visual impairment (S2021-VI-34) appreciated that recorded lectures allowed them to rewind lectures and to take breaks so that they could rest their eyes. They also could take as much time as they needed to zoom in on a particular slide and, if necessary, take a photo of it with her phone so that they could enlarge it. As described above, however, they often forgot to come back to the lecture after taking breaks.


Although procrastination was a concern raised by students with and without disabilities/mental health concerns, there were some benefits of this condensed learning (watching lectures *en masse* right before an exam). One participant with ADHD acknowledged their tendency to procrastinate, but also explained that it allowed them to efficiently grasp the relationship between concepts:

yeah I'm a huge procrastinator so most of the time I don't watch it and actually watch a week of lectures maybe a few days before the exam and then try to study everything. I think it would be better if I did it continuously, because I know it is better to learn [that way], but I think I do it really efficiently. I try to read everything through...look at all [the] pieces of information that's provided and then understanding, I guess kind of comes with looking at [how] everything's connected. (S2021-ADHD-33)

Similarly, S2020-POTS-09 appreciated the option of recorded lectures but acknowledged that they also was prone to abandoning a lecture after taking a break. They pushed themselves to watch the lectures live, and in a practice described by many other students, forced themselves to take notes as a way of staying engaged.

Yeah, so I think having a recorded lecture is helpful so I can go back and watch it whenever I want. But most of the time, I just tuned in live because I just feel lazy sometimes like to go back and watch things. So I kind of force myself to be on time to live lectures and take notes that way. (S2020-POTS-09)

In summary, prerecorded lectures meet the accessibility needs of students with disabilities, even though these students (like others) struggled with staying on task while watching them or did not always watch them in a timely manner. It is problematic when a policy denies these powerful needs, simply to paternalistically prevent procrastination.

4.2.3  *Participating in Class.* Active participation in class is a critical part of learning, but is not equally accessible to all students in traditional classrooms. As described in our earlier study [42], online classes reduced barriers to participation.

From an accessibility perspective, engaging in classes by asking questions is a positive counter force to the disengagement and detachment described by some participants with mental health concerns. This detachment sometimes compounded depressive feelings (e.g., S2020-MH-20). Some students found ways to ask questions online that reduced intense anxiety about negative judgement from peers. One participant described their approach:

...[when] class ends and you have a specific question, I would go up to the professor myself, but I would never raise my hand in a class [of] 130 people. You could say it's probably fear of rejection...Like what if I asked him a dumb question and then also the professor was like laughing at me and, like everyone is like 'Why [are they] so dumb?'. (S2021-MH-31)

In this case, the participant had used the same tactic in-person (i.e., waiting until after the class officially ended to approach the professor and ask questions) to avoid potential embarrassment. The scenario they envisioned, of an entire class laughing at them for asking a dumb question, illustrates how intensely anxiety can escalate self consciousness.

Online classes also supported engagement by providing new accessibility solutions. For example, a student with visual impairments (S2021-VI-34) appreciated that they could ask questions and add emoji as a way of expressing herself in a large class. They opted for a feature that allowed them to do so anonymously. They had not asked questions in large classes previously. Expressing oneself through technologies in this way could progress towards fuller participation.

4.2.4 🧑+🗣️ Connecting with Other Students. To support student interaction, many instructors relied on breakout sessions and group assignments. Some students had positive experiences in these settings, whereas others described accessibility concerns that relate to mental health.

In breakout sessions, where students were assigned to discuss a particular topic, it was common for students to turn off their cameras and even their microphones. Many students were discouraged by this lack of participation, something also found in prior interviews with a general student sample [42]. The lack of participation sometimes intensified feelings of isolation among students with mental health concerns.

One student with depression (S2021-MH-32) had a particularly negative reaction. They characterized this withdrawal behavior in breakout sessions as a collective statement of “I’m not here.” This sense of alienation from peers mirrored the disconnect they felt socially at home. They interacted with few people outside their household, and were not comfortable expressing their feelings and aspects of their identity to their family. The isolation contributed to their depression, which had intensified over the course of the pandemic. To pay for multiple forms of therapy, they started a job that involved considerable risk of COVID-19 exposure. They juggled the anxieties of this increased risk, for themselves and immunocompromised family members, with their treatment. The unsuccessful efforts at connection in breakout sessions and floundering class discussions seemed to reinforce their feelings of isolation from peers and their family.


Group assignments also ran counter to the needs of some participants with mental health concerns (S2020-MH-02, S2021-MH-31). For some students with mental health concerns, these group dynamics added to anxiety or disengagement, making this a less accessible solution. One student with depression described their frustration with a group project:

Our zoom meetings would take sometimes up to three hours just because either we would be waiting on someone to edit something or someone wouldn't join the call and it was just terrible....It was either you're waiting on somebody to finish or sometimes someone wouldn't even do it at all. So you're stuck with doing double the work. (S2020-MH-02)

This student’s worries about their grades and their academic standing were intensified by this communication breakdown. Like other first generation college students we interviewed, they were constantly torn between helping their family and focusing on their school work. Disorganized calls with peers on this group project ate away at their valuable study time.

As alluded to in the quote above, unequal contributions in group assignments were another source of stress. Such stressors were entwined with living circumstances and disability. One student who struggled with anxiety had to pull the weight of another student for an entire term, and then engage in the emotional labor of explaining the problem to that student (S2021-MH-31). A first generation college student, they felt constantly torn between caregiving and school. Financial stress and concern about the value of their online classes led them to shift to a community college for

one term. Their anxiety entwined with the burden compensating for peers, along with financial, caregiving and time pressures.

4.2.5  *Office hours, advising and tutoring.* Office hours and meetings with academic advisors were generally easier for students with disabilities and mental health concerns to attend online as was found in a general student sample [42]. For students with disabilities/mental health concerns, however, online office hours directly and positively impacted not only their access to the professor, but also health and access to learning materials and peer interaction.


A student with POTS (S2020-POTS-09) found it much less tiring to meet with their advisor online at a scheduled time than to race across campus to the advisor's office, with no guarantee the advisor would even be in. The physical burden of attending office hours in person can be prohibitive in such circumstances.

A student with a visual impairment (S2021-VI-34) started regularly attending office hours and other campus online tutoring for the first time during this period of online learning. They noted that as long as the instructor used screen share (rather than pointing the camera at a physical whiteboard), they were able to read content and follow along. This participant also felt unsafe walking to in-person office hours due to their race and gender. This example extends previous findings that low vision individuals face increased vulnerability to physical threats and violence [2].

The benefits of participating in office hours online, for both learning and peer interaction, were noted by students with disabilities and mental health concerns. Connection with professors and peers is valuable for supporting students' mental health but has been difficult to fully achieve in the context of online learning [42, 44]. For some, however, connecting with other students in office hours was easier online. One student with anxiety described how sharing screens felt more comfortable and less intrusive than physically looking over students' shoulders in in-person office hours (S2021-MH-31):

In person we would have people lined up for the coding classes,...like 10 of us, and 10 minutes left....then it just feels like a little competitive ...a little hostile....Online is really nice because, when someone has a question ...you can share your screen...You don't have to, all huddle over a tiny little 13 inch laptop right, you can all see it....Oftentimes another person may have the same question to me....It reinforces the feeling of community I don't feel so alone in you know feeling down ...but then also it's...really helpful, I feel like there's more knowledge to be shared. (S2021-MH-31)

There were exceptions. For example, one participant with ADHD still felt self-conscious about attending office hours and preferred to resolve questions on their own (S2021-ADHD-33).

4.2.6  *Shift from Ask and Approve to a Default of Accessibility.* With the shift to online learning in the context of COVID-19, learning models that provide accommodations became the *default*. Such accommodations were previously granted only after students submitted formal requests through the campus disability resource office.

Several students with mental health concerns (S2021-MH-32, S2021-ADHD-33) were relieved that they no longer had to request exam accommodations. At our university, policies such as open book exams and longer exam times were generally extended to all students during the period of the study. One student with depression (S2021-MH-32) said that the open book tests helped them work against perfectionistic tendencies. As mentioned earlier, they also no longer had to avoid classes that were inaccessible to them due to early morning times, or to ask for accommodations such as taking a test later in the day. Another student, S2021-ADHD-33, appreciated that many of their exams had been canceled.

Relatedly, the flexibility in grading policies and extensions granted during the pandemic were appreciated (e.g., S2020-MH-17). One student with depression appreciated the compassion their professors showed towards students during the pandemic and hoped this continued after in-person learning resumed.

You know this is definitely a unique time in all of our lives so I'm hoping that, even though we won't be in a pandemic anymore eventually...that [we will] all still be willing to be flexible and mindful of students' mental health...I think I've had the best experiences where professors are really acknowledging that we're now in destructive environments just based on circumstance...And that we will have pets, or we will be eating, or we will need bathroom break like because that wouldn't usually happen in a traditional classroom setting and I think professors were not like sticklers. (S2021-MH-32)

However, not all students with disabilities/mental health concerns benefited from such policy changes. For one student with ADHD symptoms, open-book exams were not easier.

I think my performance was a little bit lower than usual. I think my grades will be as well...which is surprising because you think that because it's open book (it would be) easier. But that's not necessarily the case. (S2020-ADHD-06)

Accommodations offered during in-person learning may not always translate to online learning. The student above (S2020-ADHD-06) may have benefited from open book exams when those were taken in a classroom. But at home they were easily distracted by screens, so an invitation to draw on online sources during an exam could backfire.

Relief from requesting accommodations related to exams and attendance is potentially significant since making such requests is itself stressful and potentially an aggravating factor for mental health issues. Some students (e.g., S2021-VI-34) held back from requesting accommodations despite obvious health concerns because they felt their problems were not as severe as those experienced by others.

5 DISCUSSION

This study identified concerns and benefits of online learning for students with disabilities/mental health concerns. In addition to analysis of survey responses during the COVID-19 pandemic, we add qualitative insights about the risks and benefits described by students with disabilities/mental health concerns. The options for recording lectures, asking questions in class via chat, and holding online office hours open doors for participation. Other aspects of online learning were not as successful, and may have had an especially negative effect on students with disabilities/mental health concerns. Our data provide a perspective on how universities can accommodate these students in meaningful ways. Below we will discuss three areas for improvement, including a broader consideration of accessibility in online learning, more flexible learning approaches and addressing the surrounding stressors on students with disabilities and mental health concerns.

5.1 Learning from Flexible Instruction Models

During the COVID-19 pandemic, online learning became the norm by necessity. As universities and instructors plan return to in-person classes, it is natural to ask what, if anything, we should retain from this experiences.

Students with disabilities that affect vision, voice, and mobility may encounter direct accessibility barriers with online learning. Much of traditional accessibility research is focused on reducing the barriers for those groups, i.e. to create equitable access in the face of stable conditions such as adding alt text to image makes a document more accessible to a blind person (e.g., [32, 55]). However an equally pressing problem for students with disabilities that are

common in higher education settings, such as chronic conditions or mental health concerns, is that technologies, or required activities, may aggravate their symptoms in some way.

Our findings suggest a need to consider the accessibility of online learning not only in terms of basic materials access but also in terms of its impacts, both positive and negative, on the embodied disability and educational experiences for this broader range of disabled students. For example, online learning can reduce fatigue, a symptom of POTS, by reducing travel needs. Illustrating more problematic factors, it is hard to disentangle online learning from the physical and social isolation experienced by students. This isolation from peers has been detrimental to learning, and may amplify the disconnection felt by students with disabilities/mental health concerns.

Our quantitative results show that when the university first announced that classes would be online, students with disabilities/mental health concerns worried that the shift to online learning would negatively impact grades, academic requirements and admission into their chosen major, but did not have as many worries after experiencing online learning. Our qualitative results explore this dynamic by illustrating some of the positives of online learning, as well as places where additional support might be needed, across a wide spectrum of disabilities. Overall, our results demonstrate that different students bring different needs to the educational experience, and that there is no single best educational model for students.

For example, building on prior findings that some students find it much easier to ask questions in online classes [42], some students with disabilities/mental health concerns reported that they were more comfortable asking questions online because they could do so in various ways without drawing attention to themselves. However, here we emphasize that many students, including students with disabilities/mental health concerns, may need more support to take the risk of speaking up in class. Indeed, some students reported that the inability to ask questions in recorded lectures and delayed responses from professors through ancillary asynchronous tools made their learning more difficult. Others reported frustration due to the lack of interaction with other students in breakout sessions, exercises that are intended to promote student interaction. In addition, many students with disabilities/mental health concerns felt more isolated and this isolation in turn, contributed to their depression and anxiety. In another example, some students benefited from watching pre-recorded lectures at different times and speeds while others found it hard to stay focused on pre-recorded lectures.

Despite students' heterogeneous responses to online education, we believe that it is possible to improve education based on these findings. Whether in person or online, we see a need for flexible approaches to instruction in future education. For many students with disabilities/mental health concerns as well as other students, online instruction directly addresses access problems. Since it is unsustainable for most instructors and learning systems to offer both in-person and online functions, there is a need for innovation on feasible ways to support students. Even simple steps such as posting slides ahead of lectures, recording lectures when possible and giving extra time for assignments appears from earlier pandemic accommodations to make a meaningful difference for students without undermining benefits of in person teaching. In the case of online learning, instructors may also want to mitigate some of the more negative impacts reported in our study by designing for closer peer-to-peer interaction and adding live discussion to accompany recorded lectures. To support this interaction, online learning could be enhanced if instructors schedule live discussions when they upload pre-recorded materials. Such class structure checks could be incorporated into accessibility checking tools in addition to checks for alt text and captions.

5.2 Disability in context: Relating life stressors to disabled students' experiences

Similar to [57], our study demonstrates the importance of viewing the whole person. Disability is often entwined with other life factors such as poverty, major life events, and other stressors. In making learning accessible, we need to consider student needs holistically.

Our quantitative analysis shows that students with disabilities/mental health concerns report higher overall levels of COVID-19 related adversity than their peers both Pre-term and Post-term (Table 1). They also reported higher level of educational concerns in the pandemic context (e.g, admission to preferred major). In addition, students with disabilities/mental health concerns reported higher exposure to major life adversities, and deeper histories of discrimination than their peers in the pre-term survey. These results indicate an overall higher level of cumulative stress among students with disabilities/mental health concerns which has been associated among undergraduate with mental health distress [48]. Research within the COVID-19 context urges a renewed focus on college student mental health, with findings akin to ours that fear and worry about their own and loved ones' health and well-being add to more normative stress sources alongside effects of isolation, financial and academic uncertainties among college students [67]. Community-based research within the pandemic has also evidenced significantly higher levels of pandemic-related stressors among adults with disabilities, with significant association to greater negative effects on their psychological well-being [17].

Our qualitative results illustrated similar concerns relating to socioeconomic pressures. Students described financial stress, job pressures, and difficulties doing school work in crowded living spaces. Multiple students are first-generation college students, who played caregiving roles at home. All of this impacted students' mental health as well as their academic engagement. In a final example, a student described the confluence of stressors related to her depression: a growing feeling of isolation, anxiety about exposing herself and family to the virus, and at the same time taking on a job that increased her COVID risk so that she could pay for therapy. Analysis of undergraduate students has established that students with multiple marginalizing statuses (e.g., disability, first generation, low income, being an international or immigrant student, having a sexual orientation other than heterosexual) experience "stacked stressors" that significantly account for greater felt stress, depression and anxiety [48].

It is clear from these examples that we cannot address accessibility concerns without also understanding contributing life factors. For example, providing students with more time on assignments may not be as effective without financial aid or other supports that can reduce their work commitments outside of school. While not all of these things can be solved by technology, they do suggest that as we innovate on the technology front, we will be able to better understand the reception of that technology (and its potential) if we are more inclusive in both the people we recruit to help us study it and the questions that we ask about its value for them.

5.3 Limitations

Our choice to combine people who identify as disabled with people who report themselves as having mental health concerns is driven by the relatively high numbers of people with impairing health concerns who do not identify as disabled [27], but may still experience accessibility barriers. There are philosophical and pedagogical questions raised by this choice about who "counts" as disabled, and this is complicated by disability invisibility [43] and under reporting [22]. Our view is that this level of mental health concern rendered these students vulnerable in the COVID-19 context. That said, we recognize that others may use differing definitions.

One limitation of this study is the small sample size. Findings may not generalize beyond students with the particular disabilities and mental health concerns described by our participants. This small sample reflects recruiting challenges (described in methods) rather than saturation. A second limitation is that many disabilities and mental health concerns are not represented in this small sample. For example, our study did not include participants with cognitive impairments, neurodiverse students, and students who are deaf or hard of hearing. A third limitation concerns the two different years of data collection; participants with disabilities and mental health concerns were interviewed in 2020 and 2021, but the general sample was interviewed only in 2020. We note the continuity of themes across these samples, but it is possible that some differences result from the year in which participants were interviewed. As noted in the results, some of the concerns expressed by students with disabilities/mental health concerns, such as isolation, disengagement and procrastination, were also expressed by students in a previous study with a general sample [42]. Although these findings overlap, such considerations may be particularly consequential for students with disabilities/mental health concerns. The sense of estrangement that comes with online learning intensifies emotional distress and adds barriers to connectedness for students who already feel marginalized in higher education.

Finally, our study only considered a subset of stakeholders at the university. In addition to students, and instructional faculty and staff, other potential stakeholders who could potentially impact accessibility include university administrators and mental health and social well-being staff. For example, given the rising rates of serious mental illness among college students [69], prevention and resilience-fostering supports and programs that specifically address disability needs (e.g., [25, 70]) could be of value.

6 CONCLUSION AND FUTURE WORK

In this article, we used a mixed methods approach to understand how the COVID-19 pandemic affects students with disabilities/mental health concerns, which helped us to identify patterns of interaction between accessibility concerns, online education, and stressors that students experience. Over the course of the study, the raging pandemic led to increases in secondary stressors (e.g., loss of income, loss of social support structures, lack of healthcare access, caregiving burdens [54, 64]). These primary and secondary stressors may be particularly detrimental for students with disabilities/mental health concerns. This is unlikely to be the last broad-scale disruptive event students experience. Even more importantly, individual lives sometimes include disruptive events. For all these reasons, increased attention to accessibility in, and the accessibility of, online and hybrid learning is critical.

Our findings show that students with disabilities/mental health concerns were more worried than other students about the outcomes of the unanticipated shift to online learning at the start of the term but not at the end of the term. The dynamic nature of these stressors is reflected in our qualitative results, where students with disabilities/mental health concerns reported some ways in which classes going online facilitated access and in other cases created barriers to access. For example, for some students the lack of interaction with others, entangled with academic, family and financial stressors, exacerbated symptoms of depression and anxiety. Based on these findings, we argue that when university seek to provide online access, they must consider both material access *and* negative impact on symptoms associated with disabilities. Further, future learning environments should support personalized and flexible learning that includes online components.

To conclude, the COVID-19 pandemic's impact on learning should be a wake-up call to accessibility researchers to study online learning technologies and their impacts, and higher education in general, from a disability perspective. Although social distancing may fade into memory, it is likely that online learning will not. The accessibility gains and challenges the COVID-19 pandemic has spurred must not be erased as we return to in-person learning.

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A APPENDIX A

Table 4. Timeline of announcements and events of relevance

Date	Event
Feb 28	Evidence of community spread discovered locally
Feb 29	First COVID-19 related death discovered locally
Mar 6	Announcement that classes would officially switch to online
Mar 13	Last day of instruction for Winter quarter and announcement that Spring quarter will begin online
Mar 18	Announcement that Spring quarter will be fully online
Mar 18	<i>Earliest date a student took the pre-term survey</i>
Mar 20	Last day of final exams for Winter quarter
Mar 23	The stay-at-home order was issued
Mar 30	Instruction for Spring quarter begins
Apr 8	<i>Latest date a student took the pre-term survey</i>
Jun 5	Last day of instruction for Spring quarter
Jun 7	<i>Earliest date a student took the post-term survey</i>
June 12	Last day of final exams for Spring quarter
Jun 22	<i>Latest date a student took the post-term survey</i>
Jun 2020; Mar 2021	Interviews conducted

B APPENDIX B

B.1 COVID-specific Survey Questions

Table 5. COVID-19 related measures and questions. We listed two measures and one question related COVID-19 (in bold) that were used in the quantitative analysis. In the *pre* survey, each answer of M1 is scored on a scale of 1 (No Concern) - 4 (A Lot of Concern) and is averaged to give a single score for measuring student concerns about classes going online. In the *post* survey, each answer of M1 is scored on a scale of 1 (Not at all stressful) - 4 (Very stressful), 0 (I did not experience this) and is averaged to give a single score for measuring the impact of online classes on student stress. Each answer of M2 is scored on a scale of 0 (No), 1 (Yes) and is summed to give a single score for measuring COVID-19 related adversities.

M1. Spring Online Classes Concerns/Stress
<p>(In pre-term survey) Do you have any of the following concerns about classes going online in Spring Quarter?</p> <p>(In post-term survey) How stressful were any of the following experiences due to the change to remote instruction in Spring Quarter?</p> <p>Moving degree requirements to another quarter</p> <p>Delaying graduation due to degree requirements</p> <p>Receiving a worse grade in a Winter class</p> <p>Impact on your visa</p> <p>Impact on your status (e.g. Dean’s list)</p> <p>Impact on your admission to major</p> <p>Impact on your financial aid status</p> <p>Having academic requirements that cannot be accomplished online</p> <p>Other (please specify)</p>
M2. COVID-19 Related Adversity

<p>Did quarantine or other effects of COVID-19 add to conflict/tension with household members?</p> <p>Did quarantine or other effects of COVID-19 lead you to feel isolated?</p> <p>Was someone in your family positive for COVID-19?</p> <p>Was someone in your family quarantined because of COVID-19?</p> <p>Did someone in your family develop a serious health problem?</p> <p>Did a family member or a close friend die?</p> <p>Were you positive for COVID-19?</p> <p>Were you quarantined because of COVID-19?</p> <p>You experienced discrimination that attribute to COVID-19?</p>
<p>Q1. Do you have a medical condition that puts you at risk for complications associated with COVID-19?</p>

B.2 Interview Guide

B.2.1 Background questions

- Can you tell me your year in school and a little bit about yourself?
- What is your living situation? How has that changed, if at all, since classes went online?
- Can you tell me your ethnicity and anything else about your identity that may affect your experience right now?
- Do you consider yourself to be part of an underrepresented or disadvantaged group?
- In what contexts are you underrepresented (e.g., as a woman in CSE but not in yoga)?

B.2.2 Health

- Do you have any health concerns or disabilities?
- Is there a name or diagnosis you use? We totally respect your experience whether or not there is a diagnosis? When did that become part of your identity/when was that diagnosis made?
- If you are registered with DRS, what accommodations do you receive? Have you negotiated those during COVID?
- How did that impact your experience with COVID? How does that play out in terms of school and your engagement in classes?
- Are there any technologies, tools, or strategies that you use to help you access classes and manage daily life related to your disabilities? (prompt assistive technologies)
- How has that changed?
- Are you using any technologies differently than you were before? Accessibility workarounds or hacks?
- What other technologies are you using now (e.g. canvas, etc)? Are those all accessible for you?
- We are particularly interested in how things have changed with regard to your health challenges since classes have gone online. For example, if any new challenges have arisen as you manage your classes and academic goals, if you have developed new approaches to studying and learning, and if you are using technology differently now.
- Have you been able to receive medical (either regular or unplanned) services? How has the pandemic changed these experiences? (e.g., are you now more or less likely to see your doctor)
- Have you been able to receive necessary goods (e.g., groceries, medications)? Have you felt safe doing so?
- How are you getting information and resources about health concerns? Or help resolving concerns? Is that information accessible?

- Have you been able to talk about your health concerns with others?
- Have you been able to get vaccinated? How has that been for you?
- Would you have felt comfortable telling someone if you thought you were exposed to the virus?
- What has made these conversations possible or difficult?
- How has this changed since the start of social distancing? For example, do you think it has become easier or harder to tell someone if you are not feeling well?

B.2.3 Educational struggles

- Tell me about how this has all been for you academically – how classes going online, etc has been for you.
- Have you had concerns about how you will be affected academically? How have online classes and instructional support been for you?
- What concerns do you have about this semester? How anxious are you about this? (grades, major admission, requirements, graduation, financial aid status) If not already covered, discuss how they are using technology, how this is/isn't working.

B.2.4 Housing

- Have you had concerns or uncertainty about where you will be living? Any concerns about the safety of where you have been living?

B.2.5 Finances

- The virus has had an enormous financial toll. Can you talk about financial difficulties that you've faced as a result of the virus, and how those play into financial challenges that you already had? Have you been able to find access to the technologies you need for education and other communication? Has your family experienced financial stress that has affected you?
- I'd like to understand if your financial concerns are immediate (are your basic needs being met right now?), in the near future (not sure about rent in a couple of months) or in the more distant future?
- Do you, or did you recently, have a job outside being a student? What is/was that?
- Concerns about the future: Do you have concerns about how life might change?

B.2.6 Social Connection

B.2.6.1 Relational health and example interactions

- * Can you describe some specific interactions you've had that were particularly significant/salient to you during this time? Any that were particularly good? Was there any special effort or any change in how you used technology? How did it occur to you to try this?
- * Were there any interactions in which you could comfortably express your feelings? Did you feel understood or cared for by the other person? Can you describe some of those interactions that brought a feeling of closeness? Was there any way in which you used technology to establish understanding?
- * How about not interactions that were stressful/ did not go so well?
- * Have you noticed any barriers to expressing your feelings now? Are there any ways in which it is harder or easier to do this now?
- * How have your strategies for feeling connected changed since the start of social distancing? Can you give an example?
- * Are there other celebrations you handled differently this year (e.g., birthdays)?

B.2.6.2 Relationships and changes in communication strategies

- * I'd like to get a sense of your relationships. Think about an inner circle of your closest contacts, a middle circle, and an outer circle of communities that you feel part of. Starting with the first inner circle, what differences are there in how you've stayed connected? Can you comment on any changes in the amount of communication or quality of connection? How has the medium of communication changed (e.g. f2f v. online)? Please share examples of specific interactions.
- * How about the middle circle?
- * And the outer circle?
- * Please describe any specific technologies you've used and anything you've done to make them fit your needs for communicating with individuals or groups in these circles.

B.2.6.3 Activities

- * I'd like to make sure we've included people you spend time with for different activities. I'll list some general categories and, if those are relevant to you, please describe how you used to interact with others for these activities (if at all) and how you do so now. For example, some people who used to go to yoga classes may stream those same streaming yoga classes. As above, please describe the technologies you've used and anything you've done to adapt them to your situation. For all of these, explore in relation to disability
 - Exercising
 - Going out/socializing
 - Studying
 - Interests/Hobbies
 - Faith or spiritual activities
 - Watching videos or listening to music?
 - Intimate connections: dating, flirting, hooking up, meeting people
 - Other
- * Would you like more social interaction than you have been having?
- * Typically, would you describe yourself as very social or less so?
- * Have you felt lonely? Did you feel lonely before social distancing? What changes have you noticed? Have you felt left out?
- * Have you felt a sense of solidarity or togetherness in your community regarding covid-19?
- * Have you found ways to help and support others? Can you describe those?
- * Has anyone else reached out to you in a way that really helped you? Can you describe that?

B.2.7 Emotion Wellbeing

- What behaviors have been helpful for your emotional wellbeing during this time?
- Are there any ways that you have used technology to support yourself emotionally (e.g., streaming videos for pleasant distraction, sharing articles or memes with friends to feel support, headphones to create boundaries in a household, etc). Please share specific examples.
- Are there ways you've used technology or others have used it during this time that have jeopardized your wellbeing (e.g., constantly reading the news)

B.2.8 Biases

- Have you seen any changes in the way others relate to you based on ethnicity, or age, health issues or vice versa? Examples?

B.2.9 Privacy

- How have you sought out information about privacy (eg. related to health info)?
- When you think about your health and telling others if you are not feeling well, do you (or have you) had privacy concerns?
- Have you changed the way you share (e.g., loosened settings or chosen to share more in specific situations) health data and other personal data during the pandemic? Do you imagine changing that at any point?