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Student vulnerabilities and confidence in learning in the context of the COVID-19 pandemic

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Abstract

How did the onset of the COVID-19 pandemic impact student learning in higher education? Everywhere, Sars-CoV-2 struck hardest in the most disadvantaged communities. This paper asks whether the virus's disproportionate effect on more vulnerable groups is replicated among college and university students. Data come from approximately 3800 students studying at nine higher education institutions located in six different countries around the globe. Conventional imagery of the 'Ivory Tower' treats colleges and universities as cloistered academic spaces beyond the 'real world.' Such imagery suggests that the patterns of COVID-19 inequity seen in the general population might not hold within higher education. However, the composition of the postsecondary student body has become more diverse and more representative. This could mean that patterns of inequity from the general population might hold, although perhaps at muted strength, among college and university students. We investigate the higher education context, asking how the characteristics of students, such as their gender or family background, their digital

access, and their living arrangements during the COVID-19 pandemic, impacted their self-reported ability to learn. The paper finds that students in more difficult situations – no study space, too much noise, and poorer health – reported greater disruption to their learning than did their peers who experienced fewer challenging living arrangements. Vulnerability, as measured by students in traditionally marginalized positions, had smaller impacts on student's confidence in learning.

KEYWORDS
Student vulnerabilities; COVID-19; digital divide; online learning; higher education; teaching and learning

Introduction

In April of 2020, the British government was accused of mislabeling the Sars-CoV-2 virus as the 'great leveller,' harming rich and poor alike (Milne 2020).[1] However, mounting evidence shows that the pandemic strikes more deeply at groups with pre-existing social disadvantages, impacting most severely people in precarious jobs and poorer communities (Kristal and Yaish 2020; Plümper and Neumayer 2020; Qian and Fan 2020).

We ask whether this differential impact was replicated within higher education. Two main factors suggest this replication might not hold, or at least might be muted. First, student populations are younger and thus less susceptible to the medical threats of COVID-19. Second, traditional views of academia as an 'Ivory Tower,' or as one of the solitudes in 'Town and Gown,'[2] imply higher education is cordoned off from the 'real world.' Conversely, students faced challenges to their wellbeing from public health policy provisions restricting social gatherings. If these challenges proved more influential for less socially advantaged students, this would suggest the differential impact might be replicated in colleges and universities (Murphy 2020). Focusing on six countries around the globe, our broadest goal is to better understand whether higher education saw sharp and systematic disparities in student learning, especially among the more vulnerable, as a consequence of COVID-19.

Background and contributions

Higher education has long welcomed the most advantaged. Selective admissions, prize-winning scholarship, and 'book knowledge' have all fostered a cultural construct of higher education as superior and aloof (Shapin 2012). Selectivity and advantage might suggest that college and university students were shielded from the pandemic's full ravages. However, post-secondary education has expanded remarkably, and rapidly, over the past few decades with a majority of secondary school graduates in most advanced nations now moving through to college and university (Kember, Leung, and Prosser 2021; Marginson 2016). The student body now has more first-generation university attenders, growing numbers of low-income enrollees, more students with family

obligations of their own, more women, and more members with mental health and other accessibility concerns.[3] Given this increasingly heterogeneous student population, it could be that differently advantaged student groups experienced COVID-19's social impacts unequally (e.g. Phillips et al. 2020).

Not only has the student population changed, but so has the delivery of teaching and learning. Educational technologies have become increasingly pervasive (Liu, Geertshuis, and Grainger 2020), as evidenced by the growing use of digital content, flipped or blended teaching, as well as the growth of learning software and hardware. But with a more heterogeneous student body, not everyone may have been equally positioned to thrive in these newer digitally mediated environments (Van Dijk 2020). With the pandemic, as most students pivoted away from face-to-face instruction, the digital divide of the non-university world came immediately into play (Hargittai 2010; Quan-Haase 2020).

Beyond a more diverse student body and the growing importance of learning technology, living arrangements under COVID-19 restrictions added complexity. As face-to-face instruction ceased, two key things happened. First, campuses closed, and with that came constraints on student support services (Raaper and Brown 2020). The resources of post-secondary life that helped mitigate recognized inequalities among students were, subsequent to the pandemic's onset, harder to access.[4] Second, remote instruction made the household the focal space for learning, but a space now occupied, in many cases, by more people sheltering at home, an effect perhaps more pronounced among non- traditional students (Murphy 2020).

What we explore is the following combination of factors: the growth of non-traditional and potentially more vulnerable student groups, a changing pedagogical landscape where technology became suddenly more prominent, and a new study environment often in more crowded house- holds distanced from traditional college and university supports. We focus on confidence in student learning as a key outcome measure. We understand learning confidence as akin to 'self-efficacy,' a factor well known to affect learning processes and stimulate academic performance (Galla et al. 2014; Panadero, Jonsson, and Botella 2017; see also Gonzalez et al. 2020).

Expectations

We have posited three interrelated vectors along which the pandemic may have disrupted student learning.

First, if the university population is now more representative of society, then the vulnerabilities to COVID-19 experienced in the broader community might, unfortunately, be replicated in higher education. Less advantaged groups within the university – for example, first-generation students, students with health challenges – would be expected to face more hardships in learning. Murphy (2020, 501), for example, argues emergency instruction 'perpetuates structural inequalities' in education.

Second, differences in digital infrastructure and online savvy among students may have had implications for their post-pandemic learning. Access to strong and reliable internet connections, along with a good quality computer, is something many take for granted but access to this necessary learning technology varies among student

subgroups (Helsper 2021). The sudden shift to virtual learning may have imperiled those lacking a sound, and easily accessible, digital infrastructure, and/or those less digitally proficient.

Third, lockdown measures which saw the home become, for many students, their new study hall, may have undermined their ability to learn. For some students the closure of campuses meant finding themselves living, and trying to learn, in more complicated surroundings, often more crowded, perhaps having to care for others, and with inadequate study space (e.g. Elmer, Mepham, and Stadtfeld 2020).

We examine the following three research questions:

(1) How did the early 2020 pivot to emergency remote instruction impact the confidence of students in their ability to learn, especially among more vulnerable student groups?
(2) How, if at all, did digital differences among students impact their confidence in learning?
(3) How, if at all, did household lockdown measures constraining the learning environment, impact the confidence students had in their ability to learn?

Research design and methodology

Project partners

On 25 March 2020 faculty from The University of British Columbia emailed an invitation to higher education teaching and learning networks (e.g. the International Society for the Scholarship of Teaching and Learning) asking colleagues to join a 'multi-institutional and multi-national study on the COVID-19 related transition to online instruction.' Participation required partners to offer university-level credit-bearing courses and self-fund their portion of the research. Nine institutions joined. Summary data in Table 1 provides a glimpse of the diversity of institutions and their student populations (more details are in Table A1 (Appendix)).

Study design

The project involved sampling courses of instruction (hereafter courses) at each institution. Where feasible, we clustered course selection within disciplines in engineering/applied science, chemistry/natural science, history/humanities, political science and psychology/social sciences. This clustering enhanced comparability among institutions while simultaneously ranging across major fields of study. We stratified course selection to optimize across year levels and enrollment sizes. Addressing what happened in a specific course, students completed a self-administered questionnaire consisting of approximately 60 closed-ended questions and 10 open-ended ones (see details here). We focused attention on a single course since teaching strategies vary by enrollment, year level, discipline, and so forth. Our unit of analysis was the student course.

Table 1. Descriptive data – based on student samples, % distributions across institutions.

	Calculated by institution			*n* of Institutions Reporting
	Lowest	Average	Highest	
Student characteristics				
n of student respondents	155	423	815	9
% Female students	46.8%	62.4%	67.9%	9
% International students	3.4%	10.6%	18.5%	9
% 1st or 2nd year students	45.4%	60.8%	76.4%	9
Institution characteristics				
% Tenure stream instructors	22.6%	49.0%	90.9%	8
% Male instructors	29.4%	59.5%	84.6%	8
Approx. size undergraduate	7000	27,000	56,000	9

Note: Institution characteristics from separate sample of faculty instructors.

Sampling during the early days of the pandemic, April and May 2020, was challenging and our sampling success varied by institution. Some partners attained good random samples (four institutions) while others faced constraints that led to quasi-random samples (five institutions). Actual response rates ranged between 30% and 50% where we had well-defined sampling frames, but were lower in institutions that had to rely upon quasi-random samples with more ambiguous sampling frames (e.g. broadcast email invitations). We address this unevenness in two ways. First, to help ensure that our results are not driven by unobservable differences across our sample, we use dummy variables as controls for institutions and degree programs. Second, we replicated our analyzes by restricting our working sample to those institutions with stronger sampling protocols and while specific results varied, our main conclusions were replicated.

Qualtrics (or equivalent) software was used to distribute questionnaires. Courses were pre- selected if the instructor was interviewed for another part of the study (see Bartolic et al. 2021). A total of just over 3800 usable student responses were received.[5] The results reported here use an unweighted sample of all respondents but we pay close attention to institutional variation to ensure that places with higher numbers of respondents do not distort results. The majority of student questionnaires were completed between April and August 2020.

Measurement

We examine six different groups of students who are, around the world, often designated as being 'more vulnerable,' 'higher-risk,' 'non-traditional,' or 'under-served' in higher education (Lederer et al. 2021 ; Phillips et al. 2020; Willems 2010). That is, on average, these students often have lower retention rates, longer times to degree, weaker grade levels, and higher academic dissatisfaction. The groups we examine are as follows, including the question we used to place students in each grouping, the coding employed, and the overall sample percentage.[6]

First-generation university students: 'Do you have a parent or guardian with a university or college degree?' [coded yes or no; 39.1% 1st generation]

Student status: 'Please indicate your student status: domestic or international' [coded domestic or international; 12.9% international]

Academic level: 'What was your academic standing during the January to April [or equivalent] term?' with response categories from 1st year to 5th year, plus other [recoded to 1st or 2nd year versus higher years; 60.6% 1st or 2nd year]

Gender: 'How do you identify your gender?' with response categories, woman, man, non-binary, prefer not to answer, and not listed, please specify [Given response numbers, recoded to a gender binary of female/male; 63.7% female]

Student loan status: 'Have you ever taken out any student loans to help fund your university [or college] studies?' [coded yes or no, 38.9% have a loan]

Accessibility registrant: 'Are you registered with your [college or university] accessibility center [or equivalent]?' [coded yes or no; 8.8% registered]

We use a series of dependent variables, as follows. We explore the extent to which students reported being 'overwhelmed' versus being 'confident' in their learning under remote instruction. We use three Likert-items for this scale, coded from strongly agree (1) to strongly disagree (7):

I personally felt overwhelmed by the transition to online learning

I was confident in my abilities to learn well in a remote online

course (coding reversed) I found it was more difficult to learn

The scale reliability is .730 (Cronbach's alpha).[7] We used principal component analysis (PCA) in calculating a weighted, three-item scale for 'Confidence in Learning,' ($\bar{x} = 0$, $SD = 1$). Students with higher confidence in their abilities to learn have higher scores.

Using a five-point scale, we asked students to rate their level of proficiency with 'web-enabled or technology-mediated course instruction.' We also asked students whether they experienced any of the following subsequent to the pivot (in parentheses are the percentage selecting each item): had 'no internet access' (3.0%), 'slow/limited internet access' (30.3%), or 'lack of adequate hardware/ devices' (6.1%). From these latter three items, we constructed a binary measure, 'weak digital infra- structure'

versus 'reasonable digital infrastructure.'

One of our questions included a statement about student health: 'My health affected my ability to attend class remotely.' If a student checked this item (4.5% did), we coded it as 'health challenges' versus 'no reported health challenges.' Next, we created an index of 'Difficult Living Situations,' which included the four items immediately above on technology and health, as well as the following: no dedicated study space (38.2%), too much noise (36.9%), too many people (28.0%), caring for children/relatives (12.3%), paid work schedule interfered with school (11.5%), unstable housing (4.6%), living in a different time zone (2.8%), and food insecurity (2.8%). Summing these 12 items produced a count variable ($\bar{x}$ = 1.98, SD = 1.79), ranging from zero (no challenges) to 12 (multiple challenges).

Analytic strategy

We present results in a series of steps. First, we present bivariate results showing the associations between students' learning confidence and their vulnerability status. Second, we probe two factors that are directly related to learning, student's self-reported digital proficiency and health. Across a wide range of tests, these bivariate relations were relatively weak. Third, we examined whether a more complicated multivariable approach would reveal stronger associations between student learning and vulnerability, now controlling for a range of possible confounding factors (e.g. digital proficiency, housing difficulties). We also explored interaction effects among vulnerability statuses (e.g. younger, international, women) but found no evidence of these. In our multivariable models, we include dummy variables, as noted above, to control for institutional and disciplinary differences.

Findings

Students frequently reported being 'overwhelmed' or 'swamped' when asked, in an open-ended question, about post-pivot learning. In response to a Likert item, 'I personally felt overwhelmed by the transition to online learning,' 59.6% agreed, with another 12.7% being neutral. Clearly, most students were challenged by the transition. Nevertheless, not all were overwhelmed, with 5.3% 'strongly disagreeing.

Using our scale of 'Confidence in Learning,' we began by examining whether students in more vulnerable groups felt more overwhelmed. On six comparisons (Student's *t*-test), only gender and year of study showed differences in confidence levels that were unlikely due to chance. None of the other factors had a statistically significant impact on student's reported level of confidence in their learning post-pivot.

Given our sample size, we have high statistical power in detecting small differences. Accordingly, we were surprised by the minimal systematic differences between groups of students in their level of learning confidence. This would have also surprised some

of our respondents, one of whom felt that the pandemic 'disproportionately harms people who are already more disadvantaged' (Student Institution A). Was it, perhaps, because the pandemic was so disruptive that it washed away most systematic influences? Was everyone's confidence in learning undermined? This interpretation is at least partially compromised by our earlier finding that some students reported not being over-whelmed by the pivot to remote instruction. In short, students had different experiences with the rapid pivoting of courses, and while a majority reported being overwhelmed, this latter grouping was not composed disproportionately of students from more vulnerable groups.

To probe the issue of vulnerability further, we asked more directly about specific difficult circumstances that students experienced. Given the pandemic, an obvious place to start was with health. Just under one in 20 students reported health issues, and we wondered whether more vulnerable students were over-represented in this group. As the middle columns of Table 2 shows, such associations are very modest. In only one of the six comparisons are the health differences between more and less vulnerable student groups statistically significant – students registered with accessibility centers report poorer health.

We were also curious about what, if any, digital differences occurred among student groups. Some students reported that internet issues in particular made it 'difficult to complete the online portion of this class' (Student Institution B). Were students in more vulnerable groups, more likely to face digital challenges? In two of the six traditionally underserved groups this was the case, for those on student loans and for women. The largest difference occurred among students who had received a student loan, where 39.6% reported weak digital infrastructure, as opposed to 32.6% of their peers. Overall, this finding provides preliminary evidence of weak digital differences.

Access to technology is one issue, but separate from that is a sense of proficiency in using the technology. When asked about their prior experience with 'web-enabled or technologically mediated course instruction,' about one in three students reported having 'some experience' or being 'highly proficient' (on a five-point scale). To examine how levels of expertise were distributed across individuals, while controlling for the disciplines and institutions in which they studied, we regressed our web-proficiency measure on indicators of student vulnerability (see Table 3).

Table 2. Self-reports of poor health and weak digital infrastructure by student vulnerability groups.

Vulnerability Groupings	% Poor health	Sig./*n*	% Weak Digital infrastructure	Sig./*n*
Student status		ns		ns
International students	7.0	37	36.9	185
Domestic students	4.5	147	32.8	1115
Year of study		ns		ns

1st or 2nd year	4.8	93	31.8	536
3rd or higher year	4.8	66	35.2	743
Gender		ns		**
Women	4.9	103	35.0	849
Men	3.8	45	29.6	408
First-generation university		ns		ns
Yes	4.5	59	35.7	540
No	4.9	99	31.8	752
Accessibility registrants		**		ns
Yes	10.8	29	36.6	113
No	3.5	95	31.9	1036
Student loan recipient		ns		**
Yes	4.9	57	39.6	458
No	4.5	82	32.6	595

Notes: Two by two Crosstabs using Fisher's Exact Test; *$p < .01$; **$p < .001$.Unweighted data, no institutional controls.

Table 3. OLS regression of student self-rated IT proficiency on student groups (with controls).

	Self-rated IT proficiency				
	Model 1	Model 2	Model 3	Model 4	Model 5
Domestic/international (Int. = 1)	−.061**	−.081**	−.066**	−.089**	−.090**
Year level (Junior = 1)	−.189**	−.157**	−.164**	−.178**	−.175**
Gender (*F* = 1)	−.010	−.037*	−.036	−.021	−.016
First-Generation University (*Y* = 1)	.012	.004	−.003	−.026	−.040
Student Loan Recipient (Yes = 1)	–	–	–	.018	.021
Accessibility Registrants (Yes = 1)	–	–	.004	–	−.005
Institution dummy variables	No	Yes	Yes	Yes	Yes
Discipline dummy variables	No	Yes	Yes	Yes	Yes
Constant	2.28	2.54	2.54	2.47	2.45
R-squared	.041	.093	.093	.070	.069
R-squared change	.041	.052	–	–	–
Sample size	3349	3349	2940	2658	2251
n of institutions	8	8	6	6	4

Notes: NB: Standardized OLS regression coefficients; * $p < .01$, ** $p < .001$.

Not all vulnerability questions were asked at each institution.[8] To account for this we estimated five separate models. Model 1, incorporating data from eight institutions, uses four measures of student vulnerability. In contrast to students in later years of study, students in years one or two of their degree programs rated themselves as being less technologically proficient ($\beta = -.189$). Inter- national students, in comparison to domestic students, rated themselves as less proficient ($\beta = -.061$). Both results were statistically significant. The effects for gender and first-generation status were not statistically significant.

Introducing controls for institution and discipline, in Model 2, creates only one proviso in relation to Model 1 – there is a weak statistically significant gender effect suggesting that at some institutions and in some disciplines, women are less confident in their learning technology proficiency. The effects for both academic level and international student status remain. Indeed, across Models 3– 5 where we introduce other vulnerability measures, these two factors remain significant. These models also suggest that institutional and disciplinary differences are at least as substantial, and in some cases more substantial factors, than are our vulnerability measures in affecting student perceptions of their technological proficiency (based on the relative size of standardized regression coefficients, not shown in the table, as well as the share of explained variance that is attributable to these latter variables). Some institutions either attract or enhance the e-learning skills of their students, and those students are likewise attracted to or benefit from e-learning experiences in different disciplines. There is, in summary, some evidence of digital differences among more vulnerable student groups, but it only applies consistently in two of the six groups considered.

Consistent with this quantitative analysis, neither digital differences nor poor health were particularly prominent themes in students' qualitative comments. Although internet access and health challenges were mentioned, these responses were overshadowed by remarks about living and study spaces. Two illustrative comments follow:

Not a quiet enough space in the house to complete school work or study 4/5 times a week. I also extremely disliked having to do presentations especially when family is home. (Student Institution C);

There's just too many distractions at home, and it's easy to say you'll do something later, as opposed to when you're at the university campus, in class. Although I enjoyed not travelling, I'm not a fan of remote learning. (Student Institution A)

Such responses, and many similar ones, imply that student learning was impeded significantly by home environments. These remarks were made by a wide cross-section of students, whether in more vulnerable student groups or not.

Table 4. Confidence in learning by difficult living situations, in %.

Confidence in learning	Levels of difficult living situations faced:			
	None	Low	Moderate	High
Overwhelmed	16.5	28.6	38.2	60.2
Moderate	32.2	38.3	35.6	27.1
Confident	51.2	33.2	26.2	12.8
Column %	100%	100 %	100%	100%
Sample Size	816	588	1031	558

Notes: Chi-square = 376.7, $p < .001$; Gamma = -.419; Unweighted data from eight institutions.

Table 4 examines the extent to which 'Difficult Living Situations' were associated with self- reported 'Confidence in Learning.' We collapsed the 12 challenging living situations into four ordinal categories, from no difficulties to those reporting the highest number of challenges. Likewise, we collapsed our 'Confidence in Learning' scale into three categories, labeled 'overwhelmed,' 'moderate,' and 'confident.' Those who reported facing the highest number of difficulties, were the most likely to feel overwhelmed in learning. Under one in five (16.5%) of those reporting no difficulties in their living situations still felt overwhelmed, whereas well over one-half, or 60.2% of those facing a high number of challenges, reported feeling overwhelmed in their capacity to learn. The differences are statistically significant and the two items are negatively associated (gamma = −.419, $p < .001$).

We test the robustness of this bivariate finding linking 'Difficult Living Situations' and 'Confidence in Learning' through a set of multivariable models in Table 5. In a first model, we include a single factor: students' self-rated proficiency with web technology. In a second model, we add our measures for more vulnerable student groups.[9] In a third model, we introduce our measure of 'Difficult Living Situations.' Finally, in a fourth model, we introduce dummy variables for institution and discipline to ensure that our findings in Models 1–3 are not a consequence of these latter factors. Model 1 shows that students who rate themselves as more proficient with digital technology, also rate more highly their confidence in learning under remote instruction. This effect holds across the different models. When we examine students from more vulnerable groups in Model 2, we find that women were more likely than men to report a lower level of confidence in their learning. The negative effect on confidence for more junior students, reported above, also holds in Models 3 and 4. For no other vulnerable group did we find significant effects, paralleling our earlier bivariate results. Model 3 adds our measure of the difficulties that students reported in living situations and it has, by far, the largest effect, with a standardized regression coefficient of −.363, substantially larger than the effect of self-rated IT proficiency ($\beta = .162$). Based on this analysis, difficulties in living arrangements, and not vulnerable populations, are the main factors that impacted student confidence in learning.[10] Model 4, where dummy variable controls are incorporated,

suggests that the effects in the earlier models hold net of institution and discipline.

Table 5. OLS regression of confidence in learning scale on 'Difficult Living Situations,' and selected other variables.

	Confidence in learning			
	Model 1	Model 2	Model 3	Model 4
Self-rated IT proficiency	.188**	.184**	.162**	.169**
Domestic/International (Int. = 1)		.025	.015	−.001
Year level (Junior = 1)		−.028	−.040	−.040
Gender (*F* = 1)		−.118**	−.078**	−.060**
First-Generation University (*Y* = 1)		.034	.051*	.004
Difficulties faced			−.363**	−.334**
Institution dummy variables	No	No	No	Yes
Discipline dummy variables	No	No	No	Yes
Constant	−.370	−.212	.185	.141
R-squared	.035	.052	.181	.221
R-squared change	.035	.017	.129	.040
Sample size	2580	2580	2580	2580

Notes: Seven institutions included – others did not ask full array of questions. Standardized OLS regression coefficients; *$p < .01$, **$p < .001$.

Table 6. OLS regression of confidence in learning on individual 'Difficult Living Situations' measures (disaggregated).

	Confidence in learning	
	Model 1	Model 2
Self-rated IT proficiency	.158**	.167**
Domestic/International (Int. = 1)	.012	−.002
Year level (Junior = 1)	−.041	−.041
Gender (*F* = 1)	−.076**	−.059**
First-generation university (*Y* = 1)	−.049*	.005
No dedicated study space	−.174**	−.167**
Too much noise	−.130**	−.118**
Poor health	−.123**	−.116**
Caring for others	−.060*	−.053*
Paid work schedule interfered with school	−.051*	−.051*
Slow/limited internet access	−.063*	−.050*
Institution dummy variables	No	Yes
Discipline dummy variables	No	Yes
Constant	.212	.178
R-squared	.196	.235
R-squared change	.196	.039
Sample size	2580	2580

Notes: Seven institutions included – others did not ask full array of questions. Standardized OLS regression coefficients; *$p < .01$, **$p < .001$.

In a final step, we unpack the aggregate effects of 'Difficult Living Situations' on students' reported 'Confidence in Learning.' In Table 6, we separate out each potentially difficult individual situation. We begin by including our measure of IT Proficiency, our measures of student vulnerability, and each of the separate difficult living situations (in the table we report only the statistically significant effects for the latter).[11] Finally in Table 6, Model 2, we introduce the controls for institution and discipline to ensure the results of Model 1 are not distorted by these two factors.

The main living situations that undermine student learning are 'no dedicated study space,' 'too much noise,' and 'poor health.' As Table 6 shows, the first of these factors has a standardized regression coefficient much larger than those of the other 'Difficulty' measures, while the 'too much noise' and 'poor health' indicators are somewhat larger than the other five statistically significant factors. The slow or limited internet access co-efficient is also statistically significant, indicating modest digital differences among students, as the self-rated IT proficiency co-efficient also shows. However, as the joint insights of Tables 5 and 6 reveal, it is the combination of different household-related factors that consistently stands out – including study space, noise, and poor health.

Discussion and conclusion

Our research investigated how, if at all, student learning was undermined in courses that pivoted to remote instruction. We examined three ways in which student vulnerabilities may have been exacerbated by public health responses to Sars-CoV-2. We highlight three findings. First, only sporadic evidence suggested that more vulnerable post-secondary student groups felt their learning disproportionately affected (consistent with Orlov et al. 2021). Second, the digital divide played a limited role in impacting student learning. Third, what mattered the most in influencing student learning was their immediate living conditions. Students who reported facing difficult living situations were much more likely to report less confidence in their ability to learn after the pivot to emergency remote instruction (see also Guppy et al. 2021).

We tested two separate ways in which the digital divide might have impacted student learning. First, we paid attention to internet access and the availability of digital hardware. Access and avail- ability were not strong predictors of confidence in learning. Second, students reporting more competence in their technological expertise, were more likely to report being confident in their ability to learn subsequent to the COVID-19 pivot. This is evidence of a digital divide defined more by proficiency than by access.

The most consequential impact on a student's confidence in learning appears to have resulted from stay-at-home and lockdown orders. For many students, household learning environments meant increased noise, congestion, and distraction. This is congruent with Elmer, Mepham, and Stadtfeld (2020) who report before and after effects of COVID-19 on student's social networks under lockdown conditions and their mental health. We find evidence as well that digital access and employment schedules also impacted studying, but not to the same extent as the crowded and noisy confines of the COVID-19 household.

From the perspective of 'Town and Gown,' it is clear that the pivot to emergency remote instruction meant that the impacts of households in the 'town' environment seriously impacted student learning. For many, two things happened with the onset of public health edicts. Living and studying were confined to the same spaces, and those spaces were more congested.

We were also concerned that non-traditional or more vulnerable students might be at higher risk of learning penalties from the pivot to remote instruction, as Murphy (2020) surmised. The initial question was whether first-generation university students, international students, students registered with accessibility centers, women, first or second-year students, and/or students from lower income families, would report lower levels of confidence in their ability to learn. We found some effects here, but differences between traditional and non-traditional students were modest and mixed.

Across the multiple tests of statistical significance used, the consistently weak effects demonstrate that vulnerability among students is not a key explanatory factor in student learning confidence. One explanation for this is captured by the

following quote, 'in the grand scheme of things, schoolwork just seemed less important' (Student Institution E). Did this grand scheme of things make for a tidal wave washing away the importance of learning for all students, vulnerable and not-so-vulnerable? Just over half of the students reported feeling overwhelmed and two- thirds reported finding it more difficult to learn. At the same time, just under two-thirds also reported feeling confident in their ability to learn well in a remote course. As one student wrote, 'It was clear that none of us - students, teachers, and TAs - performed optimally in an online environment' (Student Institution B). A focus on 'getting through' could be one explanation for why there were no systematic differences between student groups often thought to be 'at-risk' versus their peers.

An additional explanation here, while speculative, focuses upon resilience. Non-traditional students may be less familiar with the cultural nuances of a competitive academic milieu than their peers from more privileged backgrounds. However, non-traditional students tend to have developed resilience and learning strategies to cope with upheaval and precarity (Chung, Turnbull, and Chur- Hansen 2017). Though undoubtedly they too experienced significant disruption, their prior experiences may have equipped them better to adapt to the chaos COVID-19 wrought.

Several factors limit our findings. First, the lack of strong, direct measures of important high-risk markers is unfortunate (e.g. ethnicity, sexuality). We also measure more vulnerable groupings at a coarser level of granularity than we would have liked (e.g. family background). Second, while our response rates across most campuses were higher than normal, we lack robust measures of sample representativeness for some institutional cases. Third, we also need to consider who was most likely to respond to a student survey during a pandemic. It may be that those with the most challenges lacked the time or inclination to respond. Fourth, we have stressed association over causality in our interpretations. Our evidence on causal mechanisms is weaker than we would have liked but is a consequence of the nature of our data.

In conclusion, systematic evidence shows that students who experienced challenging, difficult living situations as a consequence of the sudden pivot to emergency remote instruction faced substantial learning hurdles. Public health edicts around the globe made home the central social space, for everyone, all the time. Those students who reported the most challenging living situations – inadequate study space, too much noise, poorer health – also reported facing the greatest difficulties in learning under COVID-19 conditions. Beyond living situations, we also found evidence, especially around technology, that it was more about proficiency with, rather than physical access to, adequate software and hardware.

Notes

1. The United Kingdom was not alone. Governor Andrew Cuomo of the State of New York tweeted that the rapacious nature of the Sars-CoV-2 virus made it 'the

great equalizer' (*Washington Post*, April 5, 2020).

2. 'Town and Gown' refers to relations, in university towns like Ann Arbor, USA or Cambridge, England, between the town residents and members of the university (student and faculty gowns).
3. We use several inter-related terms for these student groups – underserved, more marginalized, non-traditional, higher-risk, and more vulnerable. Operationally, we are referring to the groups enumerated in this sentence.
4. Many of our partner institutions introduced new emergency support services, including financial loans/grants and enhanced virtual counseling services. These initiatives attempted to bridge some of the divide in inequality between students, however, these supports likely had less capacity to resolve direct issues around learning, our key research question.
5. Our analytic sample includes only students in courses that transitioned to remote instruction.
6. We include women in this grouping for several reasons. Traditionally women have been underrepresented in higher education, and at least in some fields of study, remain so. Furthermore, women continue to suffer various forms of inequality (Evans 2016; Ridgeway 2011).
7. Cronbach's alpha varies by institution from a low of .61 to a high of .81 with a weighted average (student numbers equalized among partners) of .731.
8. Student loan status and accessibility measures were not asked at all institutions. Some institutions have affordable tuition and no tradition of student loans. With four institutions where all these measures are available (Model 5), loan status and accessibility are not statistically significant.
9. We dropped student loan status and accessibility measures to maximizes institutional breadth. In regressions not shown here, adding questions for loan status and accessibility, but dropping the number of institutions, we find results similar to those shown in Table 5.
10. We explored whether or not difficult living situations were associated with membership in any non-traditional student groups and we found no systematic differences.
11. Including all the vulnerability measures makes no difference here and for parsimony we incorporate only four measures (i.e. loan status and accessibility, with fewer institutions included, are non-significant).

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Appendix

Table A1. Institutional contexts – thumbnail profiles of participating institutions

Institution	*Key contextual factors*
Philippines	A private Catholic and Jesuit university in the Philippines founded in 1859 by the Society of Jesus. The Loyola Schools of the university offers arts, social sciences, sciences, and management programs to about 8000 undergraduate and 5000 graduate students, 3.7% of which are international degree students.
Australia 1	A public multi-campus university in Victoria, Australia, established in 1974 as simultaneously a distance education and F2F provider. Among the institutions included here, easily the most e-learning literate. About 45,000 undergraduates, with about one-third being international and one-third enrolled in primarily online programs.
The Netherlands	A technical university offering B.Sc. and M.Sc. degrees across nine faculties. Founded in 1956 by the Dutch government, the public university serves about 7000 undergraduates, about 7% international. The university has a strong emphasis on blended and hybrid teaching.
Canada 1	A public Institute of Technology and Advanced Learning offering a range of credentials (degrees, diplomas, certificates) with a strong focus on labor market training. Established in 1967 nearby to Toronto, Canada. About 40,000 fulltime undergraduates, 25,000 parttime, about 20% international students
Belgium	A French-speaking State University of 25,000 students distributed in 11 faculties and 4 campuses. Established in 1817. Just under 20,000 undergraduate students with about 15% international. Has a relatively smaller online presence than some other partner institutions.
Canada 2	Public university with its main campus in Vancouver, Canada, since 1915. Home to one of the world's first digital course authoring systems (WebCT). About 56,000 undergraduates, about one-quarter international. Small fully online e-learning footprint. Ranked in top 50 world universities (Times HES).
Canada 3	Located in Winnipeg, Canada, and established in 1877, a public teaching and research university with two campuses. Approximately 27,000 undergraduates, with just under 20% being international. Relatively small number of fully online courses and only one fully online degree program.
Australia 2	Located in Sydney, the University was established in 1949, and is among the top-ranked universities in the world. UNSW also has a strong focus on teaching and has about 38,000 undergraduates, 30% of whom are international. Smaller online learning profile than several other institutions included here.
United States	A public research university established in 1890 in Denton, Texas, USA. UNT has an enrollment of over 40,000 students, 32,000 of which are undergraduate. It is one of the few Tier-One Minority Serving Institutions (MSI) and Hispanic Serving Institutions (HIS) in the US. UNT currently offers 1,164 online courses and 80 online degree program options.