Supplemental Material

CBE—Life Sciences Education

Gin *et al.*

Supplemental Information for
Undergraduates with disabilities and COVID-19:
Challenges resulting from the rapid transition to online course
delivery for students with disabilities in undergraduate STEM

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This supplement contains the following:

Outreach email to DRCs

Dear Disability Resource Center,

I hope this email finds you well. We are a team of biology education researchers at [insert institution] interested in improving the experiences of college students with disabilities in undergraduate science education. We are specifically interested in the challenges and opportunities students with disabilities may have faced associated with the transition to online coursework as a result of COVID-19.

We are writing to ask if you would be willing to forward the following message (e.g. emailing list, listserv, etc.) to your students who are registered with your office at your university as we would like to conduct interviews with students to learn more about their experiences. Any information would remain confidential and communicated anonymously; our goal is to collect information from students nationally so that we can learn from each other to better serve our students. We would be happy to share back with you what we learn.

Thank you in advance for your time and consideration.

Outreach email to students

Hello Students,

We are a team of biology education researchers at [insert institution] interested in improving the experiences of college students with disabilities in undergraduate science education. We are specifically interested in the challenges and opportunities students with disabilities may have faced associated with the transition to online coursework as a result of COVID-19.

If you have a disability and were enrolled in STEM courses in spring 2020, we would be interested in how the rapid transition to online education as a result of COVID-19 has impacted your STEM courses in a 30 – 60 minute online interview.

After completing the interview, you will complete a brief demographic survey. In exchange for your time, we will provide you with a **$15 gift card to Amazon**. Participation in the research is voluntary, and you must be 18 years or older to participate.

If you would be willing to share your insights, please fill out this poll with the most convenient time for you: [link to sign up]

We are planning to conduct all interviews over Zoom for your convenience. If you have any questions, please contact [PI, PI email].

We believe that it is very important to learn more about the experiences of students with disabilities in order to create a more inclusive biology community!

Thank you for considering!

Interview script

Background:
1) Before COVID-19 (spring 2020 term), were you enrolled in any in-person STEM courses?
   [If not: end interview]
   a) Could you briefly describe the courses you are in?

2) Could you briefly describe your disability and how it impacts you on a daily basis?

3) Are you currently registered for services through your university's Disability Resource Center?
   a) Could you briefly describe your accommodations that you commonly use in your STEM courses?

4) How, if at all, has COVID-19 affected your disability in the context of your STEM courses?

<u>Online STEM questions:</u>
5) Given the transition to online instruction with the circumstances surrounding COVID-19: What do you think are some of the challenges online STEM courses present for you as a student with a disability?

6) Were your accommodations impacted or modified by the transition to online?
   a) *If yes:* Who initiated these additional modifications? You? Instructor? DRC?
      i) Please describe the process of how you received additional modifications.
      ii) How helpful was the modification for you?

7) Did you use additional accommodations for your disability in your online STEM courses?
   a) *If yes:* Who initiated these additional accommodations? You? Instructor? DRC?
      i) Please describe the process of how you received additional accommodations.
      ii) How helpful were these additional accommodations for you?

8) Do you think you would have benefitted from receiving any additional accommodations? If so, which ones?
   a) *If yes:* Did anything prevent you from getting additional accommodations?

9) What accommodations have not been helpful in your online STEM courses?

10) How could your accommodations be improved in any way for online?

11) To what extent did you have to advocate for yourself as a student with a disability during the transition to online STEM courses? Please explain.

12) Did you feel like your institution broadly supported students with disabilities during the transition to online instruction?
   a) To what extent did you feel instructors considered students with disabilities in transitioning their instruction to online?

13) Did you feel that your institution did anything that was not supportive of students with disabilities during the transition to online instruction?

14) To what extent did you feel the transition to online impacted your overall performance in your STEM courses?
   a) Did you spend more or less time on your courses after the transition to online?

15) What might you suggest to improve your experience as a student with a disability in online STEM courses?

16) Is there anything else that you would like to add?

Copy of post-interview survey questions

Thank you for taking the time to interview. We *really* appreciate it!

We would like you to take a quick (less than 5 minute) survey to tell us more about your experience with your disability in online courses and give us information so we can get you your online gift card. There are no right or wrong answers. Your answers will never be shared with anyone outside of the research team.

At the end of the survey, you will be asked for the email address you would like your Amazon gift card sent to. **We will be emailing you the gift card as soon as possible!**

1. Have you currently, or previously, been impacted by one or more of the following conditions? Please check all that apply.
    o   Learning disability (e.g. dyslexia)
    o   Mental health/psychological disability (e.g. anxiety, depression, PTSD)
    o   Physical disability (e.g. cerebral palsy, spina bifida, dwarfism)
    o   Chronic health condition (e.g. cancer, diabetes, multiple sclerosis)
    o   Visual loss (e.g. blind)
    o   Hearing loss (e.g. deaf)
    o   Other (please describe)
    o   None of these apply

2. Please write the name of your disability or diagnosed medical condition.

3. In 2-3 sentences, please describe how your disability or diagnosed medical condition affects you on a daily basis.

4. Have you been formally diagnosed for your disability or medical condition from a physician/psychiatrist/medical professional? If you selected multiple, please list each.
    o   Yes (Please list the year you were diagnosed)
    o   No

5. Are you currently (or have you previously been) registered with your university's Disability Resource Center (or equivalent office)?
    o   Yes
    o   No

6. Which institution did you attend in spring 2020? (e.g. Arizona State University, Carleton College)

7. How many science, technology, engineering, and math (STEM) courses were you enrolled in during spring 2020?

8. Did you receive any accommodations <u>prior</u> to the transition to online education?

- o Yes
- o No

9. Did you receive any accommodations after the transition to online education?
- o Yes
- o No

10. I most closely identify as

- o Man
- o Woman
- o Other
- o Decline to state

11. I most closely identify as
- o American Indian or Alaska Native
- o Asian
- o Black or African American
- o Hispanic, Latinx, or Spanish origin
- o Pacific Islander
- o White/Caucasian
- o Other (please describe)
- o Decline to state

12. I most closely identify as a

- o First-generation college student whose parents' highest level of education is a high school diploma or less
- o Non-first generation college student (at least one parent has some college)
- o Non-first generation college student (at least one parent has finished college)
- o Decline to state

13. Do you serve as a primary caregiver for someone other than yourself? (e.g. children, sick parent)

- o Yes
- o No
- o Decline to state

14. What is your parent's highest completed level of education? If you have more than one parent with differing levels of education, choose the higher of the two.
- o Less than high school completed

- o High school diploma or GED
- o Some college but no degree
- o Associate degree (for example: AA, AS)
- o Bachelor's degree (for example: BA, AB, BS)
- o Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)
- o Higher than a Master's degree (for example: PhD, MD, JD)
- o Other (please describe)
- o Decline to state

14. What is your best guess for the yearly income of the household in which you grew up?
- o Low income (less than $25,000)
- o Middle-low income ($25,000-$49,999)
- o Middle income ($50,000-$99,999)
- o Middle-high income ($100,000 to $199,999)
- o High income ($200,000 or higher)
- o Decline to state

15. Please indicate your native language (the language you spoke at home when you were growing up).
- o English
- o Spanish
- o Other (please describe)
- o Decline to state

15. Please indicate the average total time (round trip) that you spent commuting to campus per day (prior to COVID-19).
- o I lived on campus/did not commute
- o Less than 30 minutes
- o 30 - 59 minutes
- o 60 minutes or more (please specify)
- o Decline to state

16. Please indicate the average number of hours you worked a job per week during the spring 2020 semester (prior to COVID-19).

- I did not work
- 1 - 10 hours
- 11 - 20 hours
- 21 - 30 hours
- 31 - 40 hours
- 40 hours or more
- Decline to state

17. Please indicate the option that most closely reflects your college experience.
- I transferred to my institution from a 2-year college, a community or junior college, or a technical college
- I transferred to my institution from another 4-year institution
- I started my college career at my institution
- I attend a 2-year college, a community or junior college, or a technical college
- If none of the above reflect your experience, please describe your experience below.
- Decline to state

18. How long have you attended college while pursuing your undergraduate degree?
- 1 year or less (first-year student)
- 2 years (sophomore)
- 3 years (junior)
- 4 years (senior)
- 5 years or more
- I have graduated with my undergraduate degree
- Other (please describe)

19. What is your grade point average (GPA)?

20. Do you identify as a member of the LGBTQIA* community?
*lesbian, gay, bisexual, queer/questioning, intersex, asexual/aromantic
- Yes
- No
- Decline to state

21. Please select the word or words that best describe your identity.
- Lesbian

- o Gay
- o Bisexual
- o Queer
- o Transgender
- o Intersex
- o Asexual
- o Other, please describe
- o Decline to state

22. How old are you?

23. I most closely identify with

- o Currently or having previously struggled with anxiety or an anxiety disorder
- o Having never struggled with an anxiety disorder
- o Decline to state

24. I most closely identify with

- o Currently or having previously struggled with depression or a depression disorder
- o Having never struggled with depression
- o Decline to state

25. What is your ultimate career goal?

- o Medical doctor (e.g., pediatrician, surgeon, etc.)
- o Scientific researcher (e.g., research professor, biologist, etc.)
- o Other health professional (e.g., physician assistant, physical therapist, nurse, etc.)
- o Other science career (e.g., zookeeper, lab manager, etc.)
- o Other, please describe
- o I do not know what I want to do yet

Table S1. Additional interview participant demographics

Demographics	All students n = 66 % (n)
Hours worked per week	
Do not work	48% (32)
1-10 hours	17% (11)
11-20 hours	17% (11)
21-30 hours	9% (6)
31-40 hours	2% (1)
40+ hours	5% (3)
Decline to state	3% (2)
Serves as primary caregiver (e.g., to a child)	
Yes	8% (5)
No	86% (57)
Decline to state	6% (4)
Career goal	
Medical doctor	15% (10)
Other health professionals	15% (10)
Other science careers	12% (8)
Scientific researcher	20% (13)
Other	24% (16)
Undecided	11% (7)
Decline to state	3% (2)
Parent's education level	
Less than high school completed	2% (1)
High school diploma or GED	24% (16)
Some college but no degree	9% (6)
Associate Degree	2% (1)
Bachelor's Degree	18% (12)
Master's Degree	23% (15)
Doctoral Degree	15% (10)
Decline to state	8% (5)
Household income level	
Low income	8% (5)
Middle-low income	30% (20)
Middle income	33% (22)
Middle-high income	12% (8)
High income	6% (4)
Decline to state	11% (7)
Member of the LGBTQIA Community	
No	44% (29)
Yes	42% (28)
Decline to state	14% (9)

Table S2. List of students' pseudonyms with their self-reported disability types

Interview	Pseudonym	Chronic health condition (e.g. cancer, diabetes, multiple sclerosis)	Hearing loss (e.g. deaf)	Learning disability (e.g. dyslexia)	Mental health/psychological disability (e.g. anxiety, depression)	Physical disability (e.g. cerebral palsy, spina bifida)	Visual loss (e.g. blind)	Total #
1	Michael	x		x	x	x		4
2	Zhang	x			x			2
3	Luna			x	x			2
4	Pedro			x				1
5	Destiny	x		x	x			3
6	Desiree	x			x			2
7	Eva	x						1
8	Marty	x				x		2
9	Sean	x						1
10	Scarlet			x	x			2
11	Molly			x	x			2
12	Oscar	x		x				2
13	Alexis				x			1
14	Diane	x		x	x			3
15	Danielle				x			1
16	Naomi			x	x			2
17	Timothy			x				1
18	Selena			x				1
19	Angelica			x	x			2
20	Austin			x				1
21	Renea				x			1
22	Juliet			x				1
23	Bryan			x				1
24	Javier			x	x			2
25	Ilene			x	x			2
26	Peter			x				1
27	Sylvia	x			x	x		3
28	Jessica	x		x	x			3
29	Phillip	x					x	2
30	Crystal	x				x		2
31	Summer	x			x			2
32	Terry	x	x	x	x	x		5
33	Bertha		x					1
34	Ashley			x				1
35	Bella	x		x	x	x		4
36	Charlie			x	x			2

#	Name							Total
37	Alex				x			1
38	Carlos				x			1
39	Linda	x		x				2
40	Sherry	x		x	x		x	4
41	Joe			x	x			2
42	Ryan				x	x		2
43	Lizzie				x			1
44	Michelle	x						1
45	Franklyn			x	x			2
46	Alexandria				x			1
47	Natalia			x	x			2
48	Rena			x	x			2
49	Kate	x			x	x		3
50	Laura			x				1
51	Rose			x				1
52	Arielle				x			1
53	Nyeli			x				1
54	Ellen	x			x			2
55	Tom				x			1
56	Arthur			x	x			2
57	Melissa					x		1
58	Ethan				x	x		2
59	Henry		x	x				2
60	Savanah	x			x			2
61	Lydia				x			1
62	Sal			x				1
63	Katherine		x		x			2
64	Marne				x			1
65	Tanya				x			1
66	Levi			x	x			2
	Total	22	4	36	43	10	2	117

Table S3. List of disabilities reported by students

Type of Disability	Total number of disabilities reported n = 148
Chronic health condition (e.g. cancer, diabetes, multiple sclerosis)	**36**
Chronic pain	3
Ehlers-Danlos Syndrome	3
Chronic daily migraines	2
Postural Orthostatic Tachycardia Syndrome (POTS)	2
Seizures	2
Chronic sinusitis	2
Brain injury	1
Chronic active autoimmune disease	1
Chronic fatigue syndrome	1
Crohn's disease	1
Diabetes	1
Diaphragmatic hernia	1
Eating disorder	1
Epilepsy	1
Fibromyalgia	1
Gastroparesis	1
Gastroesophageal reflux disease (GERD)	1
Hip dysplasia	1
Insomnia	1
Narcolepsy	1
Osteoarthritis	1
Post-concussive syndrome	1
Polysplenia heterotaxy syndrome	1
Rheumatoid arthritis	1
Tetralogy of Fallot	1
Tremors	1
Trigeminal neura1ia	1
Working memory deficit	1
Hearing loss (e.g. deaf)	**6**
Hearing impairment	4
Auditory deficit	1
Auditory processing disorder	1
Learning disability (e.g. autism, dyslexia)	**13**

Dyslexia	5
Autism	4
Dyscalculia	2
Dysgraphia	1
Non-verbal learning disorder	1
Mental health/psychological disability (e.g. anxiety, depression, PTSD)	**79**
Attention-deficit/hyperactivity disorder (ADHD)/ Attention-deficit disorder (ADD)	25
Anxiety	22
Depression	14
Post-traumatic stress disorder (PTSD)	9
Bipolar	5
Asperger syndrome	1
Obsessive-compulsive disorder (OCD)	1
Panic disorder	1
Unspecified dissociative disorder	1
Physical disability (e.g. cerebral palsy, spina bifida, dwarfism)	**12**
Fibromyalgia	2
Interstitial Cystitis	1
Inflammatory bowel disease	1
Chronic pain	1
Complex regional pain syndrome	1
Epilepsy	1
Generalized joint hypermobility	1
Head trauma	1
Hip dysplasia	1
Nerve damage	1
Parkinson's disease	1
Visual impairment (e.g. blind)	**2**
Retina damage	1
Retina disparity	1

Table S4. Percent of students in the final dataset by institution type and geographic location

Institution	n = 66 % (n)	Enrollment size
R1 Public University in the Southwest	20% (13)	53,000
R1 Private University in the Northeast	8% (5)	14,000
R2 Public University in the Southwest	15% (12)	29,000
R2 Public University in the Midwest	7% (4)	20,000
R2 Public University in the Northwest	21% (14)	27,000
M1 Public University in the Southwest	5% (3)	13,000
M1 Public University in the Northwest	23% (15)	16,000

Table S5. Coding rubric with code descriptions

Reported issues with specific accommodations or resources no longer being available following the transition to online instruction
Theme	**Description**
Lack of reduced-distraction testing environment	Student describes that they no longer had access to their reduced-distraction environment testing from home. A student may be distracted from their surroundings at home during testing. This could also include instructors that opted to use Zoom video/audio to administer exams, which student may mention is distracting by seeing/hearing other students during exam. If a student describes that sharing their screen leads to stress/anxiety, it would be coded here.
Extended testing time was not properly administered	Student describes that there were issues with the way they were supposed to receive extended testing time. This could be that the instructor forgot to add it to the system, there was not a way to add it to the system, or that they had to specifically ask for it to be added after taking an exam without the extended time.
Lack of access to note-taking accommodations	Student describes that they were no longer able to access their note-taking as an accommodation although they would have found this helpful. Student could describe an issue with being able to communicate with the student who used to give them their notes, the DRC no longer facilitating this process, or some other reason that they are no longer able to access their notes from their course due to the change in format.
Lack of (reduced) access to campus/tutoring resources	Student describes that they had no access or reduced access to campus tutoring resources. Student could mention that the university/college did not offer tutoring online after the transition, the online tutoring was difficult to navigate, or they were unsure how to access tutoring resources after the transition to online. This could also include resources such as the library, computer labs, etc.
Unique challenges with online instruction that may have been lessened with an accommodation
Issues with test proctoring technology	Student describes that there were issues with the systems that instructors chose to proctor their exams online. A student could describe that the proctoring system would flag them for cheating if they took a break (as one of their accommodations) during an exam. This could also be any issues with the proctoring system leading to an increase in anxiety for the student. Note: This is an issue with the testing system itself and not with the instructor administering it. This could be increased anxiety due to the way in which exams are proctored.
Reduced access to material or information	Student describes that there is little real-time feedback or ways for the student to get help when they may be struggling with a particular task or assignment. Student often describes that they have difficulties getting questions answered, contacting the instructor/TA, or that there is a delay in them receiving what they need to complete an assignment/task. This could also be access to an instructor after class or in office hours.
Video delivery of information is not always accessible	Student describes that videos are not always in a format that is accessible to them. This could include students who describe videos as not being closed-captioned or transcribed. It could also include students discussing that watching videos results in strain, fatigue, stress, etc. A student may also mention that their existing technologies (e.g. screen readers) are incompatible with video formatting and it makes it difficult to access.
Barriers to receiving accommodations effectively and efficiently after the transition to online instruction
Instructors did not consider students with disabilities	Student describes that the instructor did not consider students with disabilities as they transitioned online. They could have forgotten that they received a particular accommodation. A student may say that the instructor was busy with transitioning their course to online and forgot about students with disabilities. For example, an instructor may have not put in extended time for the students in their course that take their exams at the DRC and receive extended time. In general, this could come in the form of students with disabilities not being considered in the transition to online.
Instructors made assumptions about	Student describes that the instructor made assumptions about what was or was not appropriate for them following the transition online. Some students may describe the instructors' rationale for this being that students have an increased time to work on assignments, they gave extended time to all students, or that

appropriateness of accommodations	their specific accommodation was no longer necessary in an online learning environment. Students need to specifically mention that they no longer were able to access or use their accommodations because the instructor did not recognize them. If an instructor no longer allows a student to use or access their accommodation, it would be coded here.
Lack of information from DRC/university about adapting/specific accommodations for online	Student describes that they felt as though there was not a plan in place about how their accommodations might change as a result of the transition to online. They did not feel as though the DRC/instructors knew what to do in terms of changing existing accommodations to better suit them in an online environment. This could be when students describe that changes were happening so quickly that the university was unable to address concerns or send out information to students about how their accommodations would be impacted or modified by the transition to online.
Student was required to self-advocate for accommodation/ modifications	Student describes that they had to self-advocate for what they needed. This could be in the form of emails/phone calls to the DRC. It could also be communicating with the instructor to work on modifying their accommodations or ensuring that they had what they needed to be successful after the transition to online (that they would not have to do in-person; and more than what an average student would have to do). If a student mentions advocating for their needs/disability more broadly/generally, it would be coded here (unless they mention disclosing more information).