



Identifying Factors That Influence Student Perceptions of Stress in Biology Courses with Online Learning Modalities

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Students in higher education encounter many factors both inside (academic) and outside (nonacademic) classrooms that can influence their perceptions of stress in their biology courses. These can include course learning modalities, coursework, grades, as well as time management outside of class. It is unknown what stressors are perceived by students enrolled in biology courses—especially in online learning modalities. Therefore, our mixed method study aims to investigate the extent to which online course modalities influence students' perception of stress, as well as identify academic and nonacademic factors that influence students' perceptions of stress in biology courses. Student survey data ($n=240$) was collected in the Fall 2020 semester while many courses were held online due to the COVID-19 pandemic. Our qualitative and quantitative analyses indicated three major findings: First, 70% of students specifically indicated that online-learning modalities increased their stress levels. Our second major finding is that 70% of students indicated the size of class workloads—work both in and out of class—is too much, which especially impacts students with caretaking and work responsibilities. Finally, over 85% of students indicated that exams were a major source of stress, specifically, a third of the students reported the time to complete the exam and exam material as sources of stress. This work is the first to identify stressors in online biology courses, and these analyses will inform future pedagogy, curriculum, and policies to mitigate students' stress as instructors continue to explore online learning pedagogy.

KEYWORDS stress, online learning, student experiences, instruction, stress

INTRODUCTION

Students encounter many stressors in their everyday lives, and high levels of stress can reduce their academic performance (1). For students in higher education, many variables or factors influence whether they perceive stress, and these can include factors specifically related to courses (academic factors), or factors outside of courses (nonacademic factors). Some academic factors include pressure to perform on exams, instructor actions, coursework, and experience with educational skills. Nonacademic factors, such as student identities, and time spent at their jobs and with family can also influence students' perception of stress and ultimately influence their classroom experience (2, 3). Regardless of the source, students under constant stress not only have physiological implications but also mental health

issues that can lead to symptoms of depression and burnout (4, 5). We predict that these mental health issues could contribute to students leaving biology majors. Therefore, if students' academic performance decreases while dealing with stress, it is important to research ways to help students cope and/or mitigate stress—but first, we must identify the specific sources of stress in biology students (6).

Given the COVID-19 crisis, researchers and educators are working on developing strategies to support students in these unprecedented times. For example, shifting assessment use and the content covered in courses can support students during the pandemic (7). As educational institutions switched learning modalities from face-to-face to online or hybrid formats (meaning a portion of the course was taught online), instructors need to consider how these online experiences impacted students. Due to this abrupt transition, many researchers are investigating the experiences of students in this novel environment and how we can best support students in this context, specifically those that are working or have family caretaking responsibilities due to the pandemic (8–11). It will be important to continue to investigate strategies that not only increase student performance but improve student emotional wellbeing in these online environments with the increased amount of online

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biology courses—which, to an extent, may remain after the COVID-19 crisis (12, 13). However, before we can identify strategies to incorporate into online teaching, we need to first identify what factors students report that impact their perceptions of stress in biology courses, especially as students navigate online environments.

With the prevalent online and blended course modalities, this study aims to identify what academic and nonacademic factors influence biology students' perceptions of stress in order to develop future mitigation strategies to support students' learning experiences in biology courses in a variety of contexts (12, 13). As students navigate these novel environments, we as educators need to identify ways to support our students and understand their experiences; therefore, through a mixed method approach, we aim to address the following research questions:

1. To what extent does online course modality influence students' perception of stress?
2. What academic and non-academic factors influence students' perceptions of stress?

METHODS

Context and participants

The study population consisted of students enrolled in one or more biology courses at a public institution located in a major metropolitan area. The university provides educational opportunities to students from inner-city, suburban, and rural populations. As a result of the COVID-19 pandemic, many lecture courses switched to online learning modalities. Courses with lecture and laboratory components became hybrid where students were online for lectures and in-person for laboratories. During the Fall 2020 semester, the modalities were as follows: four in-person lecture and/or laboratory-only courses, six asynchronous lecture-based courses, nine synchronous lecture-based courses, and 12 hybrid courses with asynchronous lecture and synchronous laboratories that were either online or in-person.

The majority of the student population consisted of white/non-Hispanic, undergraduate students (Table 1). Students that identified as black/African American, Hispanic/LatinX, Alaskan Native/American Indian, Pacific Islander/Native Hawaiian were categorized as underrepresented minorities (URM). Here, caretaker status meant the student was required to take care of someone at home, such as siblings, grandparents, or others needing assistance. Class status was determined based on graduate, post-bachelors, and undergraduate students. Student's employment status was categorized as either none, one part-time job, or more than one part-time job. This student population also consisted of transfer students and first-generation college-going students, meaning they are the first in their immediate family to attend college.

Students participated on a volunteer basis and could choose to remove themselves from the study at any point. Students were required to answer questions for consent and

TABLE 1
Student participant demographics (n = 240)

Demographic	Total	
Year	Graduate	18
	Post-bachelors	1
	Undergraduate	221
	Senior	43
	Junior	45
	Sophomore	78
	Freshman	55
Transfer status	Transfer student	46
	Non-transfer student	194
First-generation status	First-generation college-going	50
	Not first-generation college-going	189
Self-reported gender	Cis-gendered woman	179
	Cis-gendered man	54
	Other (includes non-binary, gender queer, and transgender students)	7
Self-reported orientation	Heterosexual or straight	208
	LGBTQIA+	29
	Decline to state	3
Race/ethnicity	URM	28
	Non-URM	210
Caretaker status	Caretaker	61
	Not a caretaker	152
Job status	None	71
	1 part time (PT)	115
	More than 1 PT	54

confirmation of being enrolled in one or more biological science courses prior to access to the rest of the survey. Surveys were considered complete based on agreeing to consent, biology course enrollment, and all survey items were answered. This study was approved and granted exempt status by the local institutional review board for human subjects' research (IRB #700).

Survey

We used the Perceptions of Academic Stress Scale (14) to identify factors that affect students' stress perception (Table 2). This previously validated survey was chosen based on its use for both undergraduate and graduate students in identifying stress factors. The original survey consists of 5-point agreeable Likert-scale questions based on academic and personal perceptions in academia, where questions had an internal reliability Cronbach's alpha score of 0.70. To further understand student experiences in online courses, open-ended questions were added (Table 2). These open-ended questions allowed students the opportunity to

TABLE 2
Survey items

Survey questions
I am a student taking biology course(s).
I am confident that I will be a successful student.
I am confident that I will be successful in my future career.
I can make academic decisions easily.
I fear failing courses this year. ^b
I think that worrying about exams is a weakness of character. ^b
Even if I pass my courses, I worry about getting a career. ^b
What else do you worry about as a student? ^a
Competition for grades or comparing grades with my peers is quite intense. ^b
Professors are critical of my academic performance.
Professors have unrealistic expectations of me.
Academic advisors have unrealistic expectations of me.
My family has unrealistic expectations of me.
The time allotted for classes and academic work is enough.
The size of class workloads is too much. ^b
To what extent does your learning modality impact your stress levels? Please explain your reasoning? ^a
I believe the amount of work assigned outside of classes is too much. ^b
If I get behind on classwork, I struggle to catch up. ^b
I have enough time to relax.
What other nonacademic time constraints do you have? ^a
Exam questions are usually difficult. ^b
Exam times are too short to complete the answers. ^b
Exams are very stressful to me. ^b
What about exams are stressful or difficult for you? ^a
Have you ever received a D or F in a course?
Is there anything else you would like to add that would be beneficial to the college about stressors in your life? This could be personal or academic. ^a

^aRepresents open-ended items. Survey adapted from Bedewy and Gabriel (2015).

^bStudents that responded to this question with a “Neither” response were categorized as “Agree.”

provide insight into their personal and academic experiences as an extension to Likert-scale questions. Open-ended responses went through two rounds of face validation with nine undergraduate students to ensure comprehension of the added questions. The survey was generated and distributed to students through Qualtrics in the Fall 2020 semester.

Quantitative analyses

Frequencies of students’ level of agreement for each Likert question, as well as disaggregation per student demographic, were calculated using IBM SPSS Statistic version 26.

Because the ultimate goal was to determine which demographic factors led to students either agreeing or disagreeing with a statement, logistic regression was to determine the impact of a given demographic factor on student response. One of the benefits of logistic regression is that it adjusts the significance of any given factor while simultaneously accounting for all other factors in the model (15). Given that logistic regression requires the use of dichotomized responses, students’ responses of “strongly disagree” and “somewhat disagree” were combined for disagree, and students’ responses of “strongly agree” and “somewhat agree” were combined for agree. Depending on the question, “neither” responses were categorized as either “agree” or “disagree” (see footnote b in Table 2). Logistic regression was conducted in PROC GLIMMIX in SAS (version 9.4).

Qualitative analyses

We analyzed open-text response questions with grounded theory to develop a coding rubric from the students’ responses (16). This framework was revised continuously during three rounds of analysis (17). Categories were identified individually by four researchers to develop an unbiased coding rubric. The final rubric included a category, a definition explaining the category, and examples of student evidence (Appendix A). The finalized rubric was then used to reanalyze student responses and data were coded to consensus.

RESULTS

Online learning increases students’ perceptions of stress

To understand the impact of online learning on students’ stress, we asked students to reflect on their course modality and the extent it affects their stress (Table 3). Here an overwhelming majority of students (70%, $n = 169$) reported that online course modalities increased their stress. Only 7% ($n = 17$) of students reported their stress levels decreased, and a few students (12%, $n = 28$) mentioned a mix of increased and decreased stress in their responses which were often in reference to blended modalities (both in-person and online). This increase in perceived stress was reflected across all demographics, with a notable increase in caretaker students, where almost 80% ($n = 48$) reported an increase in stress in response to online learning (Appendix B).

Qualitative evidence supports that this increase in stress is due to limited interactions with professors and other students, increased content covered by instructors due to recorded lectures, and issues with time management and online learning. Here one student said, “*Having less structure makes me more responsible for keeping on track for my classes and it’s hard to focus on ‘school stuff’ while at home with my family and my job.*” Other students mentioned they were less focused during online learning: “*I am easily distracted and having online classes is extremely hard to keep track of.*” Another example of the increased workload in online courses is seen here: “*The switch to online asynchronous is very stressful because we are spending more time in the ‘lecture’*

TABLE 3
Qualitative analyses

Question	Category	Total (%)
To what extent does your learning modality impact your stress levels?	Increase stress	169 (70%)
	Decrease stress	17 (7%)
	Both increase and decrease stress	13 (5%)
	Neither increase and decrease stress	28 (12%)
What other nonacademic time constraints do you have	Personal obligations	79 (33%)
	Family	98 (41%)
	Friends	16 (7%)
	Work	139 (58%)
	College obligations	104 (43%)
	Health/fitness	20 (8%)
	Future academics	8 (3%)
What about exams are stressful or difficult for you?	Time	69 (29%)
	Question format/design	46 (19%)
	Material/content	54 (23%)
	Test anxiety	39 (16%)
	Preparing/studying	54 (23%)
	Technology concerns	19 (8%)
	Grades	48 (20%)

setting of the course compared to the amount of time we would've spent in a face-to-face course."

Some students had a mix of modalities for their classes and they mentioned how this mix affected their experiences in school. Students with a schedule consisting of various modalities stated that it can be difficult to navigate back and forth to campus, as seen here: "Most of my courses are hybrid so going back and forth to campus changes what I do for that course on a particular day and how much sleep I get and sometimes classes will switch from on campus to online or vice versus the week or day before. . ." Students who disagreed and said the online decreased their stress levels mentioned the decrease was being able to do classes or work on their own time, so they could easily navigate and schedule classwork around their job more easily.

Course workloads are key stressors for students—especially caretakers

To determine students' level of agreement to Likert-scale items regarding students' stress perceptions, we analyzed the frequency of student responses and reported the number and percentage of "agree," "disagree" and "neither" responses (Table 4). Full disaggregated data is in Appendix C. When asked to reflect on the workloads—which includes both work in and outside of class—for their biology courses in various learning modalities, 70% of students ($n = 167$) reported that the size of class workloads was too much. Specifically, 56% ($n = 134$) of students

reported that they thought the workload outside of classes was too much. Logistic regression analysis (Table 5) determined that this is significant according to students' class (undergraduate compared to graduate), caretaker status, and transfer status. Specifically, 77% ($n = 47$) of students with caretaking responsibilities agreed with this statement compared with only 57% ($n = 87$) of their non-caretaking peers (Appendix C), representing a significant difference ($P = 0.04$) according to the model. Students reported several time constraints outside of class that would affect their workloads, such as personal obligations, family, and work (Table 5). Almost 60% ($n = 139$) of students indicated work as a major time constraint which would affect their perceptions of stress affected by course workloads.

Exams are major sources of stress for students

It is not surprising that exams were a major source of stress for students. Here 83% ($n = 200$) of students reported that they thought exam questions were difficult (Table 4). While not significant ($P = 0.73$) in the logistic regression model, it is interesting to note that there is a clear difference between students with and without caretaking responsibilities. Students with caretaking responsibilities reported an 80% agreement that exam questions were difficult compared with only 33% of their non-caretaking peers (Appendix C). This significance was observed in class (graduate versus undergraduate) level as well ($P = 0.04$). When asked specifically what about exams is stressful, 69 students (29%) indicated time was a factor, and almost 5% of students reported the content of the exam and studying for exams as sources of stress (Table 3). Despite the online format, only 8% ($n = 19$) discussed technology concerns. The following quote summarizes the concerns around exams reflected in many student responses: "Exams stress me out because I worry about getting a good grade so I can pass the class. The timer ticking down is always in the back of my head and I worry if I am doing well. . . I am unsure about what information I should take time to study more in-depth and what exactly is relevant. On these exams, I feel like am rushing to get the 50 questions done in 50 min, and do not have time to think or check my answers. I also feel that the online format that my classes are in does not allow me to prepare and study as well for the exams."

DISCUSSION

This study aimed to identify what academic and nonacademic factors influenced biology students' perceptions of stress. Along with identifying the factors, we also specifically aimed to identify the extent that online learning modalities affected students perceived stress during the Fall 2020 semester. This study comes at a time during the COVID-19 pandemic where many higher education campuses switched their normal face-to-face courses to online formats—including synchronous and asynchronous online learning. Knowing that large online performance gaps occur in younger students, students from underserved communities, and students with lower

TABLE 4
Students' level of agreement for each Likert-scale item

Survey item	Agree	Disagree	Neither
I am confident that I will be a successful student.	210 (88%)	22 (9%)	7 (3%)
I am confident that I will be successful in my future career.	225 (94%)	6 (3%)	9 (4%)
I can make academic decisions easily.	187 (78%)	34 (14%)	18 (8%)
I fear failing courses this year.	110 (46%)	107 (45%)	23 (9%)
I think that worrying about exams is a weakness of character.	41 (17%)	170 (71%)	29 (12%)
Even if I pass my courses, I worry about getting a career.	157 (65%)	59 (25%)	24 (10%)
Competition for grades or comparing grades with my peers is quite intense.	122 (51%)	54 (22%)	64 (27%)
Professors are critical of my academic performance.	142 (59%)	23 (10%)	75 (31%)
Professors have unrealistic expectations of me.	93 (39%)	85 (35%)	62 (26%)
Academic advisors have unrealistic expectations of me.	40 (17%)	133 (55%)	67 (28%)
My family has unrealistic expectations of me.	62 (26%)	124 (51.7%)	54 (22.5%)
The time allotted for classes and academic work is enough.	134 (56%)	77 (32%)	29 (12%)
The size of class workloads is too much.	167 (70%)	37 (15%)	36 (15%)
I believe the amount of work assigned outside of classes is too much.	134 (56%)	45 (19%)	61 (25%)
If I get behind on classwork, I struggle to catch up.	162 (68%)	46 (19%)	32 (13%)
I have enough time to relax.	64 (27%)	155 (65%)	21 (9%)
Exam questions are usually difficult.	200 (83%)	10 (4%)	30 (13%)
Exam times are too short to complete the answers.	115 (48%)	80 (33%)	45 (19%)
Exams are very stressful to me.	207 (86%)	16 (7%)	17 (7%)

GPA, it is important to consider what factors influence students' perceptions of stress that could contribute to these disparities (18–20). Our mixed method analysis indicates that online learning—along with nonacademic time constraints and course workloads—all increased students' perceptions of stress.

Strategies for increasing time management for students with caretaking and work responsibilities

Student academic performance and stress perceptions are affected by their time management skills and nonacademic time conflicts (21–23). Students reported that they struggled to keep up with their schedules and coursework because of not having enough time, and specifically that the time for courses conflicts with work (58%), family (41%), and other nonacademic time constraints. This is not surprising as almost 30% of the study population identified as being a caregiver, meaning they spend time providing care for others, such as parents, siblings, children, or grandparents. Due to the pandemic, higher education and many K–12 schools shifted to online learning environments, and students mentioned that they were helping their siblings and family members while at home working on their own courses. Students with caretaking and family obligations outside of academia struggle to manage time for courses, and these nonacademic obligations may be placed *above* their academics (18, 24). This could be a cultural or a personal preference, but these preferences must be acknowledged in the classroom due to differences in culture as instructors work to become more

equitable instructors (25, 26). Instructors who are aware of students with caretaking responsibilities and acknowledge their responsibilities outside of class can help mitigate students' stress by helping students navigate and schedule time for assignments, meeting deadlines, and attending office hours (2, 24). This information about students' and their needs could be collected toward the beginning of the course through classroom surveys to help instructors scaffold instructional supports and better understand how to support students' success in online environments (27, 28).

Many students also work to support themselves and their families financially, especially during a time of economic insecurity due to the pandemic. This study population included more than half of students with some form of employment and 58% of students specifically listed work as a major nonacademic time constraint. Research supports that financial concerns were a great stressor for students impacting their academic performance and possibly being a reason for students leaving higher education (29, 30). It would be beneficial for instructors to be aware of students' job status as a major time constraint. Knowing how many students are employed or have multiple jobs can help an instructor decide how to structure the course to support their students (31). To accommodate these time constraints due to personal or financial needs, instructors should hold flexible office hours, and provide many in-class opportunities for studying/practicing content to provide working students the opportunity to manage work and academic time conflicts in a supportive learning environment (2, 18, 32).

TABLE 5
Logistic regression analysis

Survey item	Effect	Class	Caretaker	Transfer	First gen.	Gender	Race	Orientation
I am confident that I will be a successful student.	Q1	0.383	0.375	0.569	0.170	0.954	0.965	0.998
I am confident that I will be successful in my future career.	Q2	0.036^a	0.731	0.610	0.504	0.997	0.516	0.795
I can make academic decisions easily.	Q3	0.441	0.964	0.328	0.003	0.659	0.272	0.998
I fear failing courses this yr.	Q4	0.245	0.792	0.486	0.037	0.471	0.038	0.935
I think that worrying about exams is a weakness of character.	Q5	0.792	0.326	0.979	0.204	0.888	0.257	0.508
Even if I pass my courses, I worry about getting a career.	Q6	0.004	0.341	0.852	0.571	0.627	0.158	0.274
Competition for grades or comparing grades with my peers is quite intense.	Q7	0.319	0.777	0.534	0.691	0.302	0.981	0.357
Professors are critical of my academic performance.	Q8	0.086	0.994	0.617	0.937	0.643	0.812	0.299
Professors have unrealistic expectations of me.	Q9	0.424	0.091	0.794	0.155	0.578	0.816	0.290
Academic advisors have unrealistic expectations of me.	Q10	0.026	<0.0001	0.478	0.958	0.979	0.964	0.342
My family has unrealistic expectations of me.	Q11	0.023	0.895	0.812	0.899	0.916	0.360	0.882
The time allotted for classes and academic work is enough.	Q12	0.765	0.690	0.533	0.298	0.994	0.409	0.120
The size of class workloads is too much.	Q13	0.041	0.043	0.014	0.468	0.997	0.714	0.735
I believe the amt of work assigned outside of classes is too much.	Q14	0.715	0.993	0.040	0.631	0.728	0.406	0.470
If I get behind on classwork, I struggle to catch up.	Q15	0.159	0.973	0.934	0.359	0.999	0.777	0.627
I have enough time to relax.	Q16	0.131	0.240	0.865	0.566	0.073	0.285	0.949
Exam questions are usually difficult.	Q17	0.948	0.728	0.627	0.633	0.962	0.659	0.377
Exam times are too short to complete the answers.	Q18	<0.0001	0.944	0.655	0.383	0.810	0.215	0.920
Exams are very stressful to me.	Q19	0.744	<0.0001	0.094	0.296	0.922	0.543	1.000

^aBold items represent significance $p < 0.05$.

To support students in online environments—especially those with caretaking and financial responsibilities—instructors should increase the structure of their courses by designing biology courses to meet clear and accessible learning goals and expectations along with providing multiple opportunities for students to engage in material both in and out of class (6, 31). These strategies disproportionately improve the experiences of students of color and first-generation college-going students in face-to-face courses, so it is expected that they will also support students in online environments (31, 33, 34). Instructors should have clear organization of their online courses, which also includes communicating expectations and time requirements of assignments, having large availability windows for assignments so students can be flexible with course engagement, establishing regular scheduled deadlines for assignments and materials, and offering multiple reminders on online platforms for students with other time constraints (35–38). Additionally, in asynchronous online

courses, asking students to schedule times to view recorded lectures will also improve students' time management (32, 38–40). Introducing other skills such as goal setting, daily planning, and prioritizing can also help students procrastinate less and identify goals in their academics which can result in more time spent on coursework (6, 19). Through purposeful scaffolds of student needs, instructors can support their students' development of time management strategies and create a more positive learning environment for students and potentially reduce stress levels for students with work and caretaking responsibilities (6, 31).

Online courses require clear communication from instructors on course expectations

The transition from face-to-face to online course modality requires students to shift how they engage with courses. Almost 70% of students agreed that the size of class workloads—the

work in and out of class—was too much, and over half of students agreed that the work specifically outside of class was too much during this transition. Students reported that they felt as if professors were assigning more work in courses with online learning modalities compared to their experiences with face-to-face courses—which may be true given instructors pre-recorded lectures without any interruptions for student engagement and questions. As this was the first time many instructors navigated online learning, instructors may have struggled organizing course material and this lack of structure may have overwhelmed students (38). In addition to managing the workload, students reported having difficulties learning in online modalities, due to technical issues (e.g., bad Internet connection, computer issues), and that it was easy to become distracted and disengaged in online courses. Students mentioned feeling that they had to teach themselves the material instead of learning from the instructor and that there was a lack of communication between students and instructors on content and deadlines. This lack of engagement between students and instructors led to students feeling more responsible for their learning and overwhelmed by not having an instructor present to keep them accountable and engaged (41).

Given the lack of interaction, students also expressed that the lack of communication created a disconnect between exam material and performance, leading to stress over exams. Students reported that exams were difficult and stressful and specifically that exam time—time needed to complete the answers or exam—was specifically a concern for 30% of students. While exams are often stressful for students, online exams may have added additional stressors, especially if these are high-stakes exams (6). Instructors and students can have misconceptions and miscommunications on course rigor and expectations and it is possible that this occurred during the pandemic as students worked online without specific, if any, guidance from their instructors (41–43). The disconnect in communication with professors can lead to misconceptions about the course and its expectations for success on exams. Students therefore may perceive an increased workload and stress over content as a result of less interaction and instructor facilitation during online settings, demonstrating the need for collaborative online activities, structured learning environments, and clear communication from instructors (6, 32, 44). Going forward, strategies to use in online settings that create a sense of community and increase student engagement need to be explored (41, 45).

FUTURE DIRECTIONS AND CONCLUSIONS

This study was completed during the COVID-19 pandemic, where course formats changed from previous semesters to ensure that proper social distancing protocols were enforced. Though we did not specifically ask students to list all the learning modalities they experienced in their biology courses, many students included responses that specifically mentioned concerns or issues with online lectures and/or laboratories. Further research in a wider variety of contexts would extend analyses to address

how online settings affect students from diverse backgrounds, and better understand students' lived experiences in these contexts. To better understand these experiences of students, future studies should follow up with interviews for more in-depth qualitative analyses to explore the extent to which course modalities impact students' perceived stress. This could help other biology departments determine which learning modalities work best for their particular student populations and how to support and reduce any inequities among students in these online learning modalities.

Literature supports that strategies—such as time management, motivation, and self-efficacy strategies—can be beneficial in navigating online learning (19, 20, 46, 47). Instructors can use the benefits of online learning, such as increased time flexibility, resources, and peer learning opportunities, to increase student experiences and increase academic performance in online settings (12). Further research is needed to determine what strategies can be put in place for online settings to help students navigate academic and non-academic time constraints that reduce students' stress (36, 48, 49). Additionally, many of these considerations and conclusions could also be incorporated into traditional classrooms as instructors begin to navigate the transition back to traditional face-to-face teaching. Whether we continue with online learning in asynchronous, synchronous, or hybrid spaces, we need to consider the role of the instructor in facilitating an equitable and successful learning environment (49). Through this research that identified factors that influence students' perceptions of stress in biology courses with online modalities, we hope that this will be used to inform online teaching pedagogies to find equitable strategies to mitigate stress perceptions for *all* students in post-pandemic teachings and beyond.

SUPPLEMENTAL MATERIAL

Supplemental material is available online only.

SUPPLEMENTAL FILE 1, PDF file, 0.3 MB.

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