Understanding the Impact of COVID-19 on University of Arizona's STEM Graduate Students

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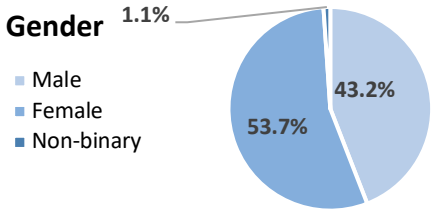
Overview

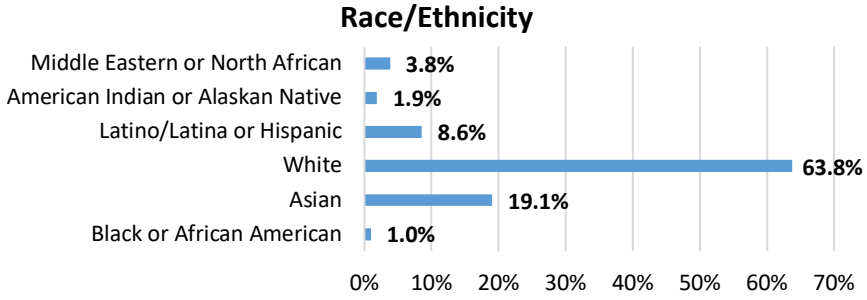
While early research indicates that students overall are being negatively impacted by the COVID-19 crisis[i], the unique characteristics and challenges of STEM fields raise important questions regarding how the pandemic may affect STEM student academic progress and career paths. In order to begin understanding how STEM student in particular are experiencing COVID, we developed a survey to assess impacts on: 1) STEM academic experience and progress; 2) STEM persistence; and 3) STEM related career and professional development.

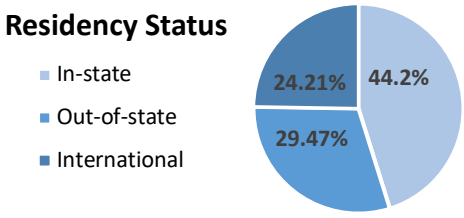
Methods

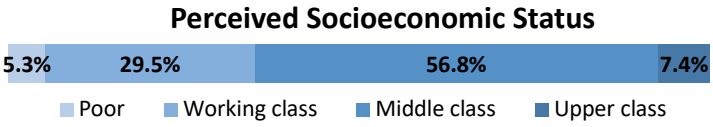
A confidential Qualtrics survey was administered between 5/4/20 – 5/29/20. We distributed the call for participation and survey link to deans, advisors, women and diversity in STEM student groups, and other WISE collaborators who forwarded our email to UArizona STEM students. Eligibility for two $100 UArizona Bursar's credit raffle was used to incentivize participation. A total of 98 graduate students participated and 95 fully completed the survey (3% of total UArizona STEM graduate population based on fall 2019 enrollment data). Data were not weighted. Statistical analysis was conducted to determine significant differences among populations in the dataset based on gender identity, race/ethnicity, caregiving status, perceived socioeconomic status, and international status.

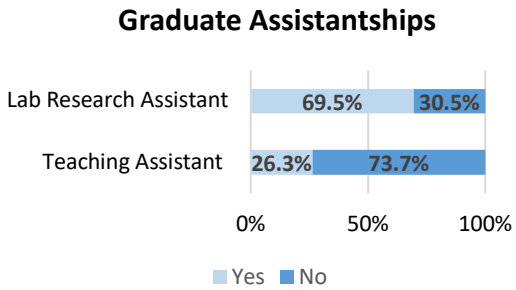
Participant Demographics

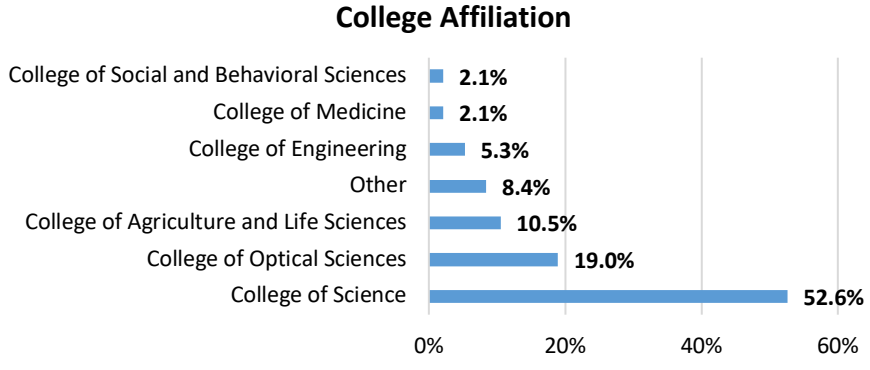












Key Findings

Academic Experience and Progress

Of graduate students still enrolled in coursework, 45% of respondents have **faced challenges** transitioning to online STEM coursework. The three most frequent challenges identified were:

- lack of motivation (23%)
- material is more difficult to understand in an online context (16%)
- difficulty keeping track of assignments and expectations (13%).

Selected Challenges Ranked by Frequency	Count (n=161)
1. Lack of motivation to engage in classes remotely	37
2. Material is more difficult to understand in online context	25
3. Difficulty keeping track of new assignments and expectations	21
4. Difficulty communicating with instructor or teaching assistants	19
5. No privacy at home to participate in Zoom classes/meetings	15
6. Other (miscellaneous: lack of peer and instructor interaction, lack of study space, etc.)	14
7. Being able to attend required online class lectures	10
8. Having access to necessary technology (e.g., computer, internet, software, etc.)	10
9. Syllabus changes have resulted in much greater workload	6
10. Time zone challenges	4

46% of respondents still taking courses reported being **satisfied** with the quality of STEM classes since moving online; 18% reported being **dissatisfied**. 11% of respondents reported being **somewhat or strongly concerned** that they would not learn enough in their online STEM classes to proceed with their academic program as planned.

"Getting a hold of partners/peers is much more difficult. This is as opposed to just seeing them and being in the same general area every day where we could easily discuss details of the projects without the overhead of planning a meet. Meeting with teachers online as opposed to in-person is also much more difficult because visual things such as using the whiteboard to demonstrate or explain things is that much harder to do online. Also, in general [I'm] just way more motivated to work on things if I see people in person."

"It has definitely affected my grades for this semester and will probably impact how long it will take me to graduate. I have not been able to start research yet."

65% of respondents thought that the COVID pandemic had a **negative impact** on their involvement in research or projects required for their academic program and 68% thought it had a **negative impact** on their research or projects important to achieving their academic or career goals.

"Because my proposed thesis had to do with working with the Navajo Nation, and they have been so hard hit with Covid-19, it was best to table that proposal in lieu of something else."

"I am unable to perform the experiments needed for my thesis work. As an experimentalist, I need to be able to operate instrumentation and the amount of work I can do on the computer is limited."

Most respondents had **not** considered deviations from their academic trajectories due to the COVID pandemic. However, a small percentage of respondents reported considering substantive shifts to their academic trajectories, including:

- Delaying graduation to stay enrolled (26%)
- Taking a temporary leave of absence (12%)
- Switching from full time to part time status (9%)

Due to the COVID pandemic, I am considering:	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
switching majors to another STEM field	0%	2%	5%	2%	91%
delaying graduation to stay enrolled at UArizona	8%	18%	8%	13%	53%
taking a temporary leave of absence from UArizona	4%	8%	4%	7%	76%
switching to part time student status at UArizona	2%	7%	7%	4%	79%
transferring to another institution from UArizona	0%	1%	3%	6%	89%

When asked to describe how they thought the pandemic would impact their STEM academic path, 39% mentioned expecting **minimal impact**. 61% report expecting negative impacts on their STEM academic paths, with **delays in research agendas** and **graduation plans** the two most prominent themes.

"Longer graduation time; perhaps I will have to become a part time student due to lack of funding opportunities past this summer."

"It will take longer for me to graduate with my PhD. I am anticipating maybe a semester to a year? It really just depends on when I can do field work."

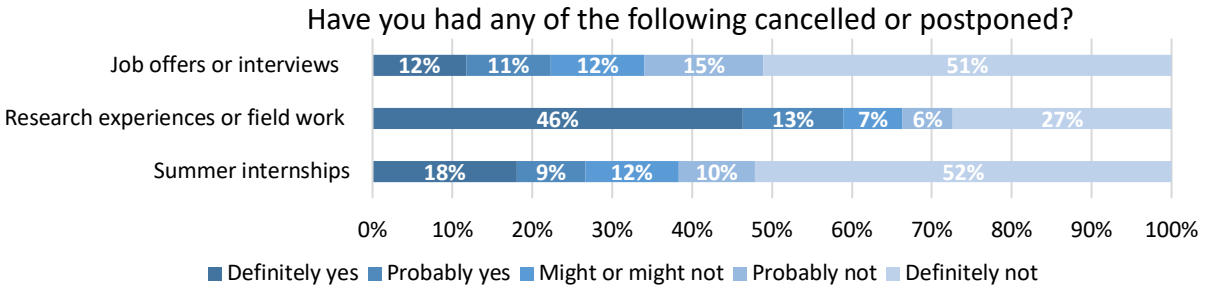
STEM Persistence

While respondents indicated that the COVID-pandemic impacted their academic experiences and progress, **their persistence in UArizona STEM will likely continue**. Only 2% of respondents reported considering switching from a STEM field to a non-STEM field, but 7% reported considering leaving higher education altogether.

Due to the COVID pandemic, I am considering:	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
switching majors from to a NON-STEM field	1%	1%	3%	3%	92%
withdrawing from UArizona without transferring elsewhere	1%	6%	3%	5%	84%

Career and Professional Development

76% of students reported that a job, research experience, or internship had been cancelled or postponed due to the COVID pandemic. Cancelled or postponed research plans were the most commonly experienced.



"Because of the large number of layoffs and furloughs, my chances of landing a job right after graduation has been severely impacted. I have had multiple interviews canceled or postponed and at least two job offers retracted or postponed."

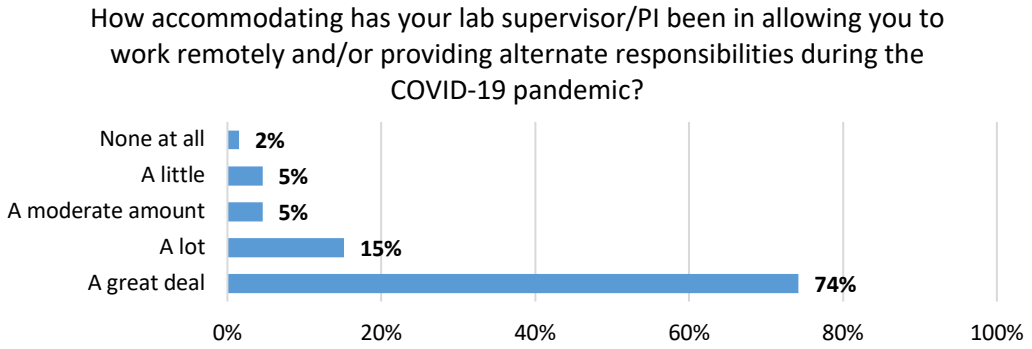
When asked to describe how they thought the pandemic would impact their **long -term STEM career path**, some respondents cited positive or neutral impacts, such as growth in particular research areas or reorientation to remote teaching and teleworking.

However, 65% of respondents cited negative impacts such as limited job prospects during economic recession and a scarcity of academic available positions.

> *"I was already thinking about leaving academia after graduating from my doctoral program and after seeing the impact this crisis has had in the university, in terms of funding, enrollment uncertainties, etc., I definitely want to leave academia and will pursue a STEM career in industry."*

Graduate Assistantships

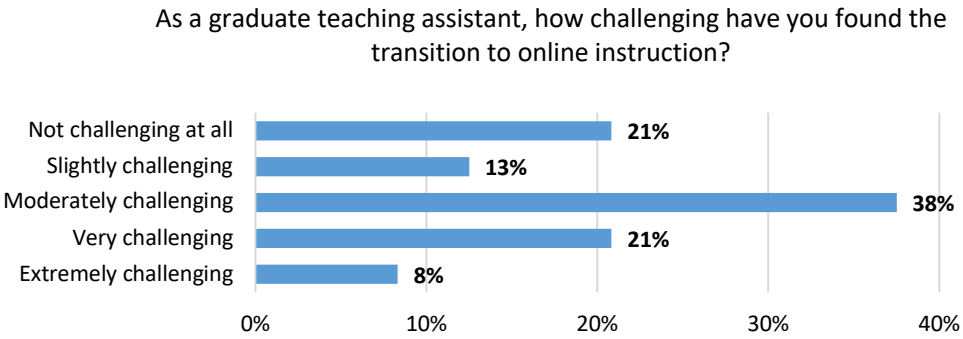
Prior to the COVID pandemic, 69% of graduate respondents worked in UArizona research labs. 93% of these research assistants felt their Primary Investigator or lab supervisor had been moderately to greatly accommodating in allowing remote work or providing alternative responsibilities due to COVID. Only 7% felt they had been accommodated only a little or not at all.



When asked if these research assistants had felt obligated to engage in lab research activities that they felt put their health at risk during the COVID pandemic, 90% responded that they did not feel obligated but 10% felt obligated. For this 10%, a variety of reasons were given as to why, including graduation timelines as well as subtle pressure from supervisor, peers, or oneself to make a good impression.

> *"How can any PhD student NOT feel obligated to continue to conduct research that is crucial to their degree program? Lab waivers pose a dilemma as it creates 2 classes of GRAs: those who are able to increase their risk of contracting COVID-19 and those who are not. Even if never explicitly stated any finding predicated on the ability of a student to conduct research in person will go to students who can do that work. Many faculty are already of the opinion that graduate students should be sacrificing sleep/free time to be as productive as possible, this attitude will certainly carry over to a student's choice to come into the lab or not. If on a summer research contract that requires in lab work, students have to make the choice to either sign a waiver to receive summer pay or lose their only source of income."*

Prior to the COVID pandemic, 26% worked as teaching assistants. When asked how challenging these teaching assistants found the transition to online instruction, 67% found it moderately to extremely challenging.



"The overhead of learning ZOOM and trying to coordinate 10+ students in my office hours is way more difficult online than in person, as in person I had an office and could just tally my time to each student or explain things to multiple students on the whiteboard. Email is also used way more extensively which is not very effective when trying to explain things to students or convey messaged where a whiteboard would be way more effective. Students also lost a lot of motivation, so they did assignments late, which put a lot of stress to my office hours during crunch time (when assignments are due). This was especially apparent when the pass/fail became a regular thing."

"It is hard to motivate and teach students. Many students don't show up to class anymore. I taught a lab that uses microscopes, so I have been having to spend hours taking photos of slides and uploading them. I just feel like the students are receiving a worse education that is filled with meaningless busy work. Labs are labs! Hands-on activities! You can't do those from home."

Vulnerable Populations

There are particular respondent sub-groups whose STEM experiences and progress have been more significantly impacted than others. However, in some cases, data indicated that groups traditionally under-represented or marginalized in STEM and higher education were *less* negatively impacted than those from dominant groups.

Caregivers

A small portion of survey respondents (13%) (compared to nearly 30% of undergraduate respondents) have taken on additional care responsibilities due to the COVID pandemic. When asked to describe their care responsibilities, students reported a wide range of tasks directed at providing for the physical, emotional, and mental well-being of siblings, children, parents, and immunocompromised family members or friends.

Even though it was a small sample (n=12) this caregiver group was comprised of students from different genders, ethnicities, and socioeconomic statuses but certain sub-groups including **men, Latinx/Hispanic students, low income students, and CALS students** were overrepresented in the caregiver group when compared to their representation in the overall sample.

Sub-Group	% of Total Respondents (n=95)	% of Caregivers (n=12)
Men	43%	67%
Latinx/Hispanic	10%	17%
Low Income	35%	67%
College of Agriculture & Life Sciences	11%	33%

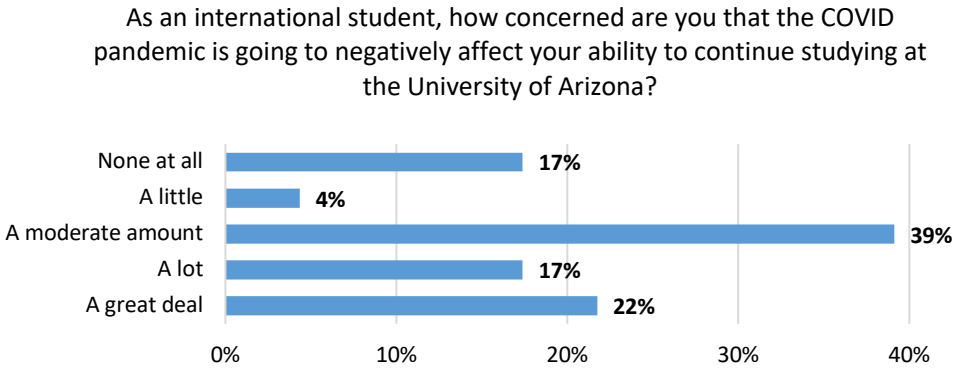
When asked about the transition to online coursework, caregiving students cited the following challenges **more on average** than their non-caregiving peers: no privacy at home to participate in classes or meetings, difficulty keeping track of new assignments and expectations, syllabus changes that have resulted in much greater workload, and a lack of motivation. Caregivers reported **slightly higher average number of challenges** when compared to non-caregivers (M_{CG}=1.67, M_{NC}=1.53). Yet overall, **caregiving status did not have a statistically significant effect** on whether one experienced challenges or the number of challenges experienced in the transition to online instruction.

What challenges have you experienced in the transition of STEM courses online?	Caregivers	Non-Caregivers
Material is more difficult to understand in online context	25%	27%
Being able to attend required online class lectures	8%	11%
Having access to necessary technology	8%	11%
Time zone challenges	0%	5%
No privacy at home to participate in Zoom classes/meetings	25%	15%
Difficulty keeping track of new assignments and expectations	33%	21%
Difficulty communicating with instructor or teaching assistants	8%	22%
Syllabus changes have resulted in much greater workload	8%	6%
Lack of motivation to engage in classes remotely	50%	37%

In addition, caregivers were **significantly less likely** than non-caregivers to report having considered switching majors from STEM to a non-STEM field (p=.011).

International Students

23 survey respondents were international graduate students. When asked how concerned they were that the COVID pandemic would **negatively affect their ability to continue studying at UArizona**," 39% said either "a great deal" (22%) or "a lot" (17%).



When compared to domestic students, international students were **significantly more likely** on average to report **positive impacts** on their research and projects required for their academic program (p=.007, medium effect) and **positive impacts** on research and projects important to achieving their academic and career goals (p=.023).

No significant differences were found between international and domestic students with respect to their reporting on future enrollment plans.

Low-Income Students

Perceived socioeconomic status was shown to have a **statistically significant relationship** with consideration of one's **academic future**. When asked about the transition to online coursework, low income (self-identified poor and working-class) experienced slightly more challenges on average (M_{LC}=1.76) than their middle-class (M_{MC}=1.61)- and upper-class peers (M_{UC}=1.56).

Low income respondents cited the following challenges more frequently on average than their middle and upper-class respondents: material is more difficult to understand online, having access to necessary technology, no privacy at home to participate in Zoom classes/meetings, and difficulty keeping track of new assignments and expectations.

What challenges have you experienced in the transition of STEM courses online?	Poor & Working Class	Middle & Upper Class
Material is more difficult to understand in online context	30%	25%
Being able to attend required online class lectures	9%	12%
Having access to necessary technology	18%	7%
Time zone challenges	3%	5%
No privacy at home to participate in Zoom classes/meetings	27%	10%
Difficulty keeping track of new assignments and expectations	24%	21%
Difficulty communicating with instructor or teaching assistants	18%	21%
Syllabus changes have resulted in much greater workload	6%	7%
Lack of motivation to engage in classes remotely	39%	39%

No significant differences were found between low income and middle- and upper-class students with respect to their reporting on future enrollment plans with the exception that low income respondents were less likely than those who identified as middle or upper class to report they had considered switching from full to part time status (p=.031).

Under-represented Minority Students

When compared to white STEM students, under-represented minority (URM) students (Black, Native American, and Latinx) were on average significantly **less likely** to consider taking a temporary leave of absence than their white peers (p=.001).

On average, URM respondents were **less likely** to report that the COVID pandemic had a negative impact on their involvement in required research or projects and less likely to report a negative impact on research (p=.004) or projects important to achieving their academic or career goals than their white counterparts (p=.008).

On average, **URM women** respondents reported **more challenges** than URM men and white women, but fewer challenges than URM men. Yet overall, URM status and gender did not have a statistically significant effect on whether one experienced challenges or the number of challenges experienced in the transition to online instruction.

Sub-Group	Average # of Challenges Reported
URM Women	1.80
URM Men	1.43
White Women	1.26
White Men	1.94

Recommendations

While more research would be needed to fully understand the way in which the COVID-pandemic is impacting STEM graduate students and how these experiences vary across demographic groups, findings do suggest a number of places where there appear to be significant negative impacts on STEM graduate student experiences. Proactively working to develop policy and procedures that can mitigate these negative impacts is crucial for retaining current STEM graduate students and supporting their success, while also working to ensure that already existing disparities in STEM participation and persistence are not exacerbated. Based on these findings and existing research, we suggestion that department and college level leadership:

- Develop programs to better prepare and support graduate student teaching assistants for shifts from in-person to remote teaching formats. Integrating sessions into already existing graduate teaching assistant trainings on how to create courses or assignment structures that are easily adaptable from in-person to remote may be a particularly efficient model for preparing graduate teaching assistants in times of uncertainty.
- Develop and adopt clear and consistent guidelines on funding and progress timeline modifications during times of crisis. This would help alleviate student stress regarding academic progress and financial well-being—stresses that are known to negatively impact productive, quality of work, and mental health.
- Develop greater support infrastructure at the departmental and college level to provide assistance to graduate students whose research agenda has been slowed, interrupted, or cancelled. Create support networks for graduate students and faculty advisors to encourage creative problem solving, collaboration, and networking in the face of large-scale disruptions to existing research agendas.
- Recognize that a small, but significant, number of graduate students have taken on additional care responsibilities due to the pandemic and that many of these responsibilities may not subside once at the start of the semester. Ensuring that caregivers are able to continue with their academic programs may require greater flexibility and related policy development on the part of departments and colleges, especially around issues of flexible work schedules and remote work and class attendance options.
- Ensure that students are being prepared for non-academic, as well as academic, career paths in order to support graduate student transitions into the workforce in the midst of expected declines in academic positions in the coming years. This is a key area where cross-departmental/college/university programming could more efficiently support students as opposed to department level efforts.

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Contact Stephanie Murphy (sumurphy@email.arizona.edu) and Jill Williams (JillMWilliams@email.arizona.edu) with questions or to request Zoom presentations and Q&A sessions.

[i] Daniels, B, Das, J., Hamza, A., Leydier, B. (2020). Covid-19 Diaries: Early Impressions from an Online Questionnaire. *American Ethnologist.* 1 May. Available at https://americanethnologist.org/features/collections/covid-19-and-student-focused-concerns-threats-and-possibilities/covid-19-diaries-early-impressions-from-an-online-questionnaire