

Understanding the Impact of COVID-19 on University of Arizona’s Undergraduate STEM Students

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Overview

While early research indicates that students overall are being negatively impacted by the COVID-19 crisis¹, 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.

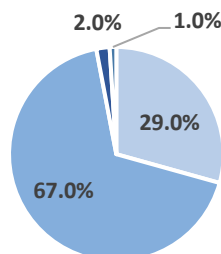
Methods

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 431 students participated and 403 fully completed the survey (3% of total UArizona STEM undergraduate population based on fall 2019 enrollment data). Data were not weighted and thus only reflect trends from the respondent sample. Statistical analysis was conducted to determine significant differences in responses among populations in the dataset based on gender identity, race/ethnicity, residency, caregiving status, and perceived socioeconomic status.

Participant Demographics

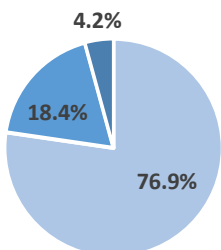
Gender

- Male
- Female
- Transgender
- Non-Binary



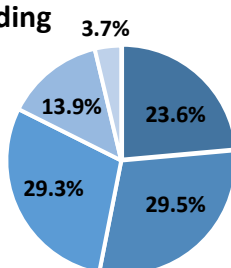
Residency Status

- In-State
- Out-of-State
- International

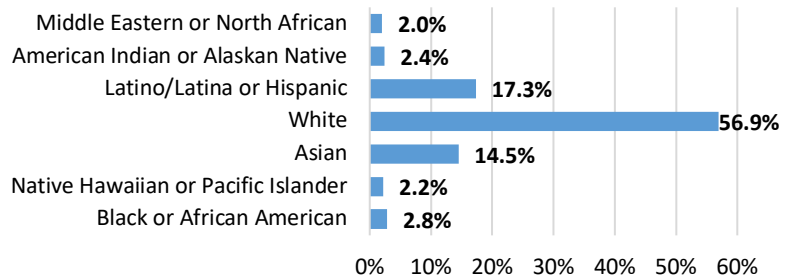


Current Class Standing

- First year
- Second year
- Third year
- Fourth year



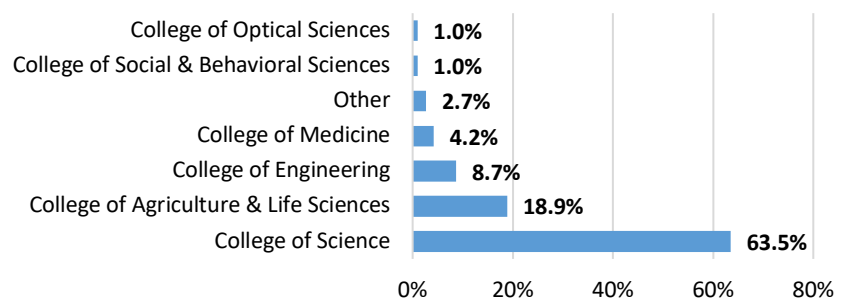
Race/Ethnicity



Perceived Socioeconomic Status



College Affiliation



Key Findings

Academic Experience and Progress

Almost **84%** of respondents reported they have faced challenges transitioning to online STEM coursework. The three most frequent challenges identified were:

- lack of motivation (19%)
- material is more difficult to understand in an online context (18%)
- difficulty keeping track of assignments and expectations (16%)

Selected Challenges Ranked by Frequency	Count (n=1503)
1. Lack of motivation to engage in classes remotely	290
2. Material is more difficult to understand in online context	269
3. Difficulty keeping track of new assignments and expectations	242
4. Difficulty communicating with instructor or teaching assistants	164
5. No privacy at home to participate in Zoom classes/meetings	154
6. Syllabus changes have resulted in much greater workload	151
7. Being able to attend required online class lectures	113
8. Having access to necessary technology (e.g., computer, internet, software, etc)	64
9. Time zone challenges	25
10. Other (miscellaneous: lack of focus, lack of tutoring, lecture delivery methods, etc.)	31

50% of respondents reported being **satisfied** with the quality of STEM classes since moving online; **38%** reported being **dissatisfied**.

“Moving to online classes has made it difficult to do well in my STEM courses, so I haven't been able to absorb as much of the material as I usually do, and I anticipate having a more difficult time in any courses that follow from the STEM courses I'm currently taking because of this.”

35% 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.

“I think the pandemic will affect my STEM academic path because of the ways in which I feel my learning has been inhibited. I don't feel as if my education was as worthwhile or rewarding this semester and it worries me in regard to future semesters. While I still was able to keep up, I am not confident in all of the content presented to me and it worries me to think I am underprepared for future courses because the transition online jolted my learning methods.”

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 (14%)
- Taking a leave of absence (11%)
- Switching from full time to part time status (6%)

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	1%	7%	7%	11%	73%
delaying graduation to stay enrolled at UArizona	5%	9%	14%	11%	62%
taking a temporary leave of absence from UArizona	2%	9%	8%	11%	70%
switching from to part time student status at UArizona	1%	5%	8%	12%	73%
transferring to another institution from UArizona	1%	3%	7%	8%	81%

STEM Persistence

While respondents indicated that the COVID-pandemic impacted their academic experiences and progress, **their persistence in UArizona STEM will likely continue**. Only **6%** of respondents reported considering switching from a STEM field to a non-STEM field and only **2%** 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 to a NON-STEM field	1%	5%	4%	6%	84%
withdrawing from UArizona without transferring elsewhere	0%	2%	4%	5%	88%

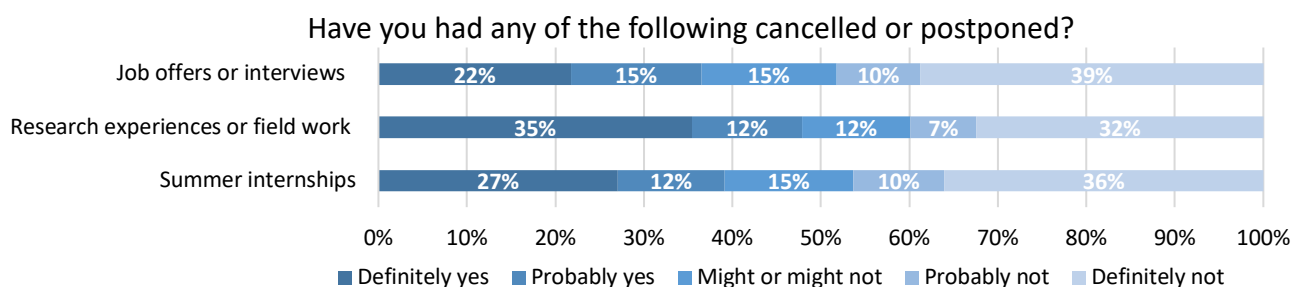
“All of the stress from being a STEM major and all of the breakdowns I have had over science classes has made me reconsider being in STEM. The breakdowns were caused by a mix of the aforementioned stress and the stress of being inside with no social interaction and lack of sun and exercise.”

Career and Professional Development

58% of respondents thought that the COVID pandemic had a **negative impact** on their involvement in required research or projects and **61%** thought it had a **negative impact** on research or projects important to achieving their academic or career goals.

“Hands-on research internships in labs that I applied for over the summer have been cancelled and replaced with a virtual training. Although I am grateful, it won’t be the same learning experience in conducting actual research. I may have a harder time finding another position/job once I return to campus in the fall as well.”

67% of students reported that a job, research experience, or internship had been **cancelled or postponed** due to the COVID pandemic.



“I was accepted to the UBRP [Undergraduate Biology Research Program] earlier in the year, and we had originally planned to begin the week after finals. Now, we are planning to start July 1, but it is not guaranteed. As a result, I am not able to participate in the workshops UBRP was originally providing, and I cannot begin helping in the lab I signed up with. Currently, maintenance of the organisms in our lab is considered essential research, but there is worry that we will not be able to maintain them long enough or adequately enough, and that it will impact the projects.”

Vulnerable Populations

There are particular sub-groups of respondents whose STEM experiences and progress have been more significantly impacted than others.

Caregivers

Over a quarter of survey respondents (**28%**) had 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.

This caregiver group was comprised of students from different genders, ethnicities, and socioeconomic statuses but certain sub-groups including **women, Native American and 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=403)	% of Caregivers (n=114)
Women	67%	75%
Native American	2%	7%
Latino/Latina/Hispanic	17%	25%
Low Income	32%	39%
College of Agriculture & Life Sciences	19%	28%

When asked about the transition to online coursework, caregiving respondents cited **more challenges on average** than their non-caregiving peers ($M_{CG}=4.13$, $M_{NC}=3.46$). Caregivers cited almost all the challenges more frequently than their non-caregiving peers with the exception of time zone challenges and lack of motivation. Overall, **caregiving was found to have a statistically significant relationship to the number of challenges one experienced** ($p=.001$).

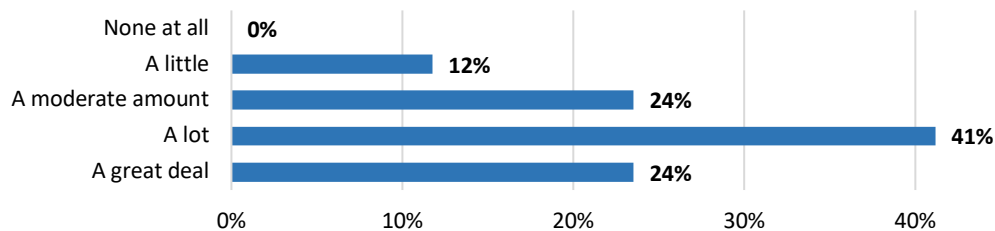
While no significant difference was found between caregiving and non-caregiving students with respect to how satisfied they were with the quality of STEM classes since moving online, **caregiving students were significantly less likely to report feeling confident they would learn enough in their online STEM classes to proceed with their academic program as planned** ($p=.005$).

With respect to future enrollment plans, **caregiving students were significantly more likely than non-caregiving students to report taking a temporary leave of absence** ($p=.033$), **or delaying graduation to stay enrolled** ($p=.001$, medium effect). While not meeting the threshold for 95% confidence interval, caregivers appeared to be more likely than their non-caregiving peers to have considered switching to a non-STEM major ($p=.053$).

International Students

17 survey respondents were international undergraduate students. When asked how concerned they were that the COVID pandemic would negatively affect their ability to continue studying at the UArizona, **65%** said either “a great deal” (24%) or “a lot” (41%).

As an international student, how concerned are you that the COVID pandemic is going to negatively affect your ability to continue studying at the University of Arizona?



On average, international students reported experiencing **fewer challenges** in the transition to online learning than their domestic peers ($M_{IS}=3.29$, $M_{DS}=3.65$). When compared to domestic students, international students were significantly **more likely** to agree that they had considered delaying graduation to stay enrolled at UArizona ($p=.017$, medium effect).

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 or working class) students experienced **more challenges on average** than their middle-class and upper-class peers ($M_{LC}=3.96$, $M_{MC}=3.53$, $M_{UC}=3.20$). The only challenge experienced more by middle- and upper-class respondents were time zone challenges. Low income socioeconomic status was found to have a **statistically significant effect on the number of challenges reported** ($p=.024$).

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	67%	66%
Being able to attend required online class lectures	34%	25%
Having access to necessary technology	23%	13%
Time zone challenges	2%	7%
No privacy at home to participate in Zoom classes/meetings	45%	35%
Difficulty keeping track of new assignments and expectations	62%	59%
Difficulty communicating with instructor or teaching assistants	48%	37%
Syllabus changes have resulted in much greater workload	40%	36%
Lack of motivation to engage in classes remotely	74%	70%

Respondents who identified as poor or working-class were **significantly more likely** than those who identified as middle- or upper-class to report they had considered delaying graduation ($p=.020$) or had considered switching from full to part time status ($p=.039$).

Under-represented Minority Students

Historically underrepresented minority (URM) STEM students (Black, Native American, and Latinx) reported experiencing **more challenges on average** than their white counterparts ($M_{URM}=3.72$, $M_w=3.39$) but the differences in number of challenges experienced, future enrollment plans, and caregiving duties were **not found to be statistically significant** between URM respondents and their white or non-under-represented minority peers.

No significant differences were found between Latinx/Hispanic students and non-Latinx/Hispanic students with respect to the number or type of challenges they experienced, their future enrollment plans, or caregiving duties.

While based on a small sample ($n=12$), **Native American respondents were significantly more likely to have taken on additional caregiving responsibilities** than respondents who were not Native American ($p=.001$, medium effect). All but 2 of these 12 respondents reported taking on additional COVID related caregiving responsibilities. Native American respondents were also **less likely to report considering switching to a non-STEM major** ($p=.001$, medium effect) but **more likely to consider switching from full to part time status** ($p=.001$, large effect) than non-Native American respondents.

While based on a small sample ($n=14$), **Black respondents were found to be significantly more likely to have taken on additional caregiving responsibilities than respondents who were not Black** ($p=.010$). They were also **significantly less likely to report considering switching to another STEM major** ($p=.020$) or **switching to a non-STEM major** ($p=.005$) than non-Black respondents.

Under-represented Minority Women Students

On average, **URM women were most likely to report having taken on additional COVID related caregiving responsibilities** followed by URM men and white women. White men were the least likely to report having taken on additional caregiving duties. The relationship between one's URM/gender identity was found to have a **statistically significant small effect** on whether one had taken on additional caregiving during the pandemic ($p=.049$).

Group	Caregiving Average (1=Yes, 0=No)
URM Women	0.38
URM Men	0.26
White Women	0.24
White Men	0.19

On average, URM women respondents reported more challenges than white men and white women, but slightly fewer challenges than URM men. URM men were most likely to report experiencing the challenge of difficulty communicating with instructors, followed by white men, then followed by URM women. White women experienced this challenge the least of the four groups. On average, white women were the most likely to report experiencing the challenge of syllabus changes creating greater workload, followed by URM women then URM men. White men were the least likely to report experiencing this challenge. **The relationship between ones URM/gender identity was found to have a statistically significant effect on whether one experienced the challenge of difficulty**

communicating with instructors ($p=.003$) and **the challenge of syllabus changes creating greater workload** ($p=.036$). While statistically significant, both of these observed differences were shown to have a **small effect size**.

Group	Average # of Challenges Reported
URM Women	3.67
URM Men	3.78
White Women	3.49
White Men	3.10

On average, URM women were less likely to consider delaying graduation than URM men, about equally likely to consider delaying graduation as white men, but more likely to consider delaying graduation than white women. **The relationship between ones URM/gender identity was found to have a statistically significant effect on whether one had considered delaying graduation** ($p=.027$). On average, URM women were less likely than URM men and white men but more likely than white women to consider switching from full to part time status. The relationship between ones ethnic/gender identity was found to have a statistically significant effect on whether one had considered switching from full to part time status ($p=.016$). While statistically significant, both of these observed differences were shown to have a small effect size.

Recommendations

While more research would be needed to fully understand the way the COVID pandemic is impacting undergraduate STEM students and how these experiences vary across demographic groups, findings do suggest a number of places where policies and procedures should be developed to mitigate the negative impacts of the COVID-pandemic on STEM students now and to prepare for future crises. Proactive policy development and preparation is particularly crucial for ensuring that already existing disparities in STEM participation and persistence are not exacerbated. Based on the findings and existing research, we suggestion that department and college level leadership:

- Encourage STEM faculty to dedicate substantive time to review key concepts and ideas covered in spring 2019 in fall 2020 courses and/or to create free standing key concept review sessions to be held early in fall 2020. These actions may help to mitigate lower levels of knowledge acquisition and comprehension in foundational STEM courses due to the shift to remote learning, while also mitigating student anxiety regarding their ability to proceed with their academic plan.
- Evaluate the feasibility of scaling-up existing research opportunities and internships for STEM students in academic year 2020-21 in order to mitigate the large number of cancellations that occurred in spring and summer 2020.
- Encourage and enable flexibility in curricular and course expectations (e.g., remote internships; asynchronous and remote course options) in order to facilitate persistence and success among students who have had to take on additional caregiving responsibilities due to COVID—responsibilities that will not necessarily subside by the start of the fall semester and that disproportionately fall on already under-represented students.
- Develop standardized policies for how information is shared with students and how expectations (e.g., due dates) are communicated in on-line contexts if an unexpected shift to remote learning is required. Standards should also be set regarding syllabus modifications and increasing course workloads during transitions to remote learning. This would help ease student transitions into online learning and reduce frustration among students, facilitating persistence and success, particularly among lower-income students and URM students.

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.

¹ 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>