"I haven't really made those connections that maybe most would their first year": A qualitative study of the COVID-19 pandemic and student social capital among 3 Cohorts of first-year engineering majors.

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Abstract

The COVID-19 pandemic disrupted the education of students of all ages and challenged teachers and academic support services to make major adaptations to continue to support student learning while also limiting the spread of the virus. Our team received an NSF grant in the Fall of 2018 to broaden participation in engineering by recruiting and retaining students who have been historically marginalized in engineering. We focused our research on first-year students who participated in pathway programs which provided peer and formal mentoring, success coaching, shared classes, and social activities, that would provide a sense of community and shared engineering identity for participants. We sought to conduct interviews at the end of their first year. Our interviews had been set to begin in April of 2020. This paper is a qualitative study of our unanticipated research on student experiences from three different cohorts of first-year engineering students and their experiences during the COVID-19 pandemic (n=32). Using a theory of social capital, we contrast the different experiences of students who entered their freshman year and experienced the pathway program at different stages of the pandemic. The experiences of students within and between these cohorts varied considerably, however themes emerged among the three distinct cohorts. Using qualitative methods, we demonstrate how the pandemic impacted first-year engineering students at different points of entry during the pandemic. Many students reported “loss of connection” and deep feelings of “isolation” associated with the pandemic precautions meant to stop the spread of the virus. Pandemic precautions taken by the university negatively impacted all students academically and socially to some extent, but there were also unique challenges for first-year students who entered college during the fall of 2020. We conclude by sharing how pathway programs helped to buffer student social isolation and how students found resilience to overcome social and academic obstacles.

Introduction

The transition from high school to college is a major life event for young adults [1]. In the United States approximately 63% of youth who complete high school go on to enroll in a 2-year or 4-year college or university [2]. The decision to enroll in college is influenced by a number of factors with college students citing cost as the most important consideration [3], [4]. The COVID-19 pandemic resulted in a significant decline in enrollment for first-year students, especially among youth from lower socioeconomic backgrounds [5], [6]. Among students who did enroll in college as first-year students in the Fall of 2020, the dropout rates were higher for first generation and low-income students, exacerbating inequalities that already existed [7]. The long-term impacts of the pandemic will be felt in higher education for the next decade [8], [9]

and achievement gaps for students from high poverty and racially segregated school districts will be magnified as a result [10], [11].

The policies enacted at colleges and universities in the Midwest were meant to keep students and faculty safe from the virus while also allowing them to continue their education and learning with as limited disruption as possible. In many ways, these policies were a large-scale social experiment and the impact on student academics and short-term and long-term mental health are only now being studied [12]–[15]. It is clear that the pandemic itself caused serious stress and mental health crises for most people in the United States, not just college students. During the course of the pandemic, college students might have faced instability in housing, loss of work or income for themselves or their families, and the risk or reality of the seriousness of contracting the virus for themselves and for their loved ones who might have heightened risk of serious morbidity and mortality [16]. In this larger social-ecological context, college students were impacted across every level of their lives and we are just now understanding the negative impact these social, familial, and personal stressors impacted mental health [17], [18]. These stressors were felt most severely by students of color, first generation college students, and first and second-generation immigrant students [19].

The timing of the transition to college during the unfolding of the COVID-19 pandemic meant that different cohorts of students had different experiences. The cohort with the most severe disruptions were those graduating high school when the COVID-19 pandemic first emerged as a global health crisis resulting in many schools pivoting quickly to fully remote learning. These students had their senior year of high school disrupted including altered graduations and cancelled social events. Additionally, as they transitioned to college that fall, many first-year students traditionally are required to live on campus, and yet these students encountered a very different first-year residential experience than those who came before them or after them. Still, students at every stage of their education, not just those transitioning from high school to college, encountered a variety of policies aimed at limiting the spread of the virus including required masking, mandatory COVID testing, social distancing, de-densification of classrooms and housing, and greatly curtailed extra-curricular activities [20]. While many large universities had options for in-person classes, remote learning and modifications to attendance policies were widespread [20].

In addition, college students who were already enrolled before the pandemic also had to consider altering their academic course-taking in the wake of online/remote learning [21]. In a study of urban low-income college students conducted in the summer of 2020, researchers found that many enrolled college students considered dropping classes and changing graduation plans, and freshman to sophomore retention rates dropped dramatically [16]. In one study, freshman who were sent home during the stay-at-home orders in the spring of 2020 had worse mental health than their upper-class counterparts, likely due to disruptions in housing [22].

Students who entered college in the 2021-2022 academic year (AY) experienced school closures and remote learning mostly as juniors and seniors in high school. This may have impacted their ability to take college entrance exams, although many universities made these tests optional for

admission in response to the pandemic [23]. While these students may have faced less intensive COVID-19 related policies on campus than the cohort who came before them, their learning experience in high school, particularly in cumulative subjects like mathematics and AP courses, may have put them at a disadvantage during their first year at college. This cohort also was not able to visit prospective colleges and universities in-person, thus limiting their ability to compare different college campuses and make decisions about best fit based on those visits [24], [25].

Social Capital

Students enter college with varying levels of social capital. Social capital is the number of social ties that students have that provide them access to knowledge and resources to navigate institutions including colleges and universities [26], [27]. Colleges and universities often provide programming and orientations aimed at connecting students with resources and helping them to build social capital on campus [28]–[30]. Unfortunately, the COVID-19 pandemic and the necessary policies aimed at limiting the spread of the virus resulted in many students being physically and socially isolated on campus [31], [32]. College students may have had less in-person contact with peers, mentors, tutors, faculty and advisors as many services were being delivered remotely [21], [33].

Recent research on the experiences of first-year engineering students during the COVID-19 pandemic highlights the challenges they faced and the strategies they used to adapt and persist in their education [12]–[15]. In a survey of 110 faculty and 627 engineering students assessing the impact of remote learning in the spring of 2020, students and faculty discussed difficulties with classroom engagement via online platforms and fatigue associated with spending hours a day attending online classes [12]. Particularly for students in engineering, a lack of hands-on learning during this period was perceived to create an experience deficit that might reverberate in later years. Another qualitative study followed first-year engineering students over time to understand to what extent their perceptions and experiences about online learning changed [13]. This study found that many anxieties about online learning remained throughout the course of the qualitative study, and that students were particularly concerned about their ability to effectively build connections and foster relationships in online settings. While first-year engineering students faced many challenges with online learning, not all experiences were negative. Some students were able to adapt and sometime even thrive in online settings [14]. Through innovative teaching methods, online learning may actually be beneficial to students in some specific areas like spatial reasoning [34]. Howcroft and Mercer (2022) found that many students found a mix of asynchronous and synchronous learning, open book exams, and the ability to rewatch lectures as generally positive changes [13].

The present study focuses on three cohorts of first-year engineering students who were participants in a student success mentoring program. While we were initially interested in understanding what programmatic aspects helped to create connections and a sense of belonging in students who belong to groups historically underrepresented (URM populations in STEM, the COVID-19 pandemic created challenges and opportunities for our research and evaluation team. Our first data collection interviews were planned for April of 2020. Due to the shutdown of in-person learning the month prior, we quickly pivoted our study design to conduct interviews

remotely and updated our study protocol with a question about COVID-19 (see Appendix A). This paper focuses on how these three cohorts of engineering students navigated their first year on campus during different stages of the pandemic. We use a sociological lens in order to investigate how history and biography intersect for first-year engineering students navigating their transition to college from 2019-2022 [35]. We share quantitative data at the college level to compare outcomes related to retention and GPA among the three cohorts and assess differences for students involved in these programs compared to students who did not have the same supports. We find evidence to support that despite adaptations student success programs delivered online/remotely were able to build social capital among participants in ways that may have helped to buffer some of the social isolation and negative mental health impacts of the COVID-19 pandemic, particularly compared to students who did not participate in these programs.

Methods

Study Context

This study emerged from a larger longitudinal exploratory study focusing on how student support services provided to cohort-based affinity groups impact URM student belonging and retention. This study was conducted at an R1 public land grant university in the Midwestern United States. The engineering college has two campuses with over 3,500 undergraduate students across 7 academic departments and 13 undergraduate degree programs. Approximately 75% of students are in-state, 83% are male and 74% are white only.

With funding from external agencies and internal resources, many colleges and universities have begun student success programs aimed at students who belong to groups historically underrepresented in engineering. We focused on interviewing students who had participated in two cohort-based affinity group programs: students who belong to race/ethnic groups underrepresented in engineering, and students who belonged to or supported people who belonged to underrepresented gender groups in engineering (most often women). These programs are open to incoming first-time freshmen who have been admitted into the college and who indicate they support diversity in engineering.

Applications for URM support programs open in October each year with recruitment occurring in December and January and applications accepted through February 1st. Students must apply by writing a short essay about their commitment to diversity. Once accepted, students receive a $500 scholarship each semester for a total of 8 semesters.

The programs' goals were to support students' academic success, support students' professional and career development, and to provide community building to support the students' interpersonal development. The learning objectives and outcomes were designed to help retain first- to second semester and first- to second-year students, help participants to complete their degrees within 6 years, help students to engage in at least one experiential learning opportunity (internship/co-op, undergraduate research, study abroad, or other), and to help students connect with a faculty member who cares about them.

Students in these programs received access to the following services: a group study session, engineering resource center, cohort specific first-year seminar sections, one-on-one success coaching, and professional and career development activities (e.g. social events, mixers, speakers and panels).

Sample

A total of 62 first-year students, and 28 junior students who participated in the URM student success programs were identified by program leaders, and contact information was shared with the researchers. Students received up to three emails inviting them to participate in a 30-to-60-minute zoom interview. Students who participated received a $25 e-gift card. A total of 32 interviews were conducted (23 first-year students, 9 third-year students).

The first round of interviews was scheduled to take place in the spring of 2020. Due to the COVID-19 pandemic, and the abrupt switch to online learning in March of 2020, data collection for the first cohort was delayed until mid-summer. We also needed to update IRB protocols to include remote interviews as well as update the interview protocol to ask about any positive and negative experiences the students had due to the COVID-19 pandemic. Consequently, we interviewed cohort 2 (AY 2020-2021) in the spring of 2021. We then interviewed students from cohort 1 (AY 2019-2020) in the fall of 2021. Although these students were entering their third year of college (typically junior level), we used the same protocol and asked them to reflect on their first year. Finally, we interviewed the final first-year cohort 3 (AY 2021-2022) in April of 2022. Table 1 shows the timeline for the COVID-19 institutional policies at the university, when interviews occurred, and the year in school for each cohort across the study period.

Table 1. COVID-19 and Interview Timeline among Three Cohorts

	Year 1		Year 2		Year 3	
	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022
COVID-19 Policies		Shutdown - all remote learning began at spring break	Hybrid - classes could be in-person or online, attendance did not impact grade, social distancing and masks required, limited extracurricular in-person gatherings		Return to normal - some limitations to size of extracurricular events that are indoors.	
Interviews				N=11 Cohort 2	N=9 Cohort 1	N=12 Cohort 3
Cohort 1	**Freshman Year**		Sophomore Year		Junior Year	
Cohort 2	HS Seniors		**Freshman Year**		Sophomore Year	
Cohort 3	HS Juniors		HS seniors		**Freshman Year**	

In a study of the 100 largest public and private institutions in the United States, researchers found that policies related to masking and in-person learning were near universal, while colleges and universities varied in their COVID-19 testing requirements, de-densification policies and

cancelling of intercollegiate athletic activities [20]. At the university where this study was conducted the following policies were implemented:

1) All classes went remote midway through the spring 2020 semester and remained remote for the summer session.
2) Students would not be moved to probation or dismissed from the university as a result of grades earned in spring of 2020.
3) Pass/No Pass policies, and withdrawal deadlines for Spring 2020 undergraduate courses were expanded.

In general, the institution being studied was fairly aggressive in its efforts to return to in-person instruction and interactions as soon as possible. Return to in-person attendance began in fall of 2020 with mandatory testing, social distancing, room capacity limitations and mandatory masking. These policies were gradually relaxed throughout AY2020-21 and the institution was largely back to a pre-pandemic mode of operation by fall of 2021.

Analytic Methods

Our original research goal was to understand how student success programs work to build social capital and help to retain students who belong to groups historically underrepresented in engineering. However, in the process of examining the frequency of occurrence of codes, it became clear that codes related to the negative impact of COVID-19 were among the highest of occurrence. In the results below, we first look at overall academic outcomes for the three cohorts of students. This includes quantitative data on cumulative GPA, and freshman to sophomore retention rates to the university and the engineering college for the three cohorts studied. We also compare and contrast these academic outcomes for all students in the engineering college compared to students in the student success programs. Second, we share the major themes about COVID-19 that emerged within and between the three cohorts.

Results and Discussion

Academic Outcomes and Retention

Table 2 shows freshman to sophomore retention rates at the university and engineering college and cumulative GPA for all students across all three academic years by support program participation. The N represents the number of students enrolled in the engineering college annually by category. It is important to note that an increase in enrollment in the 2021-2022 cohort represents the transfer of an existing department from another college at the university to the engineering college (156 students).

Table 2. Academic Outcomes for all First-Year Students 2019-2022

Academic Year	N	% Retain to University (Fr>So)	% Retain to Eng College (Fr>So)	Avg Most Recent CGPA
2019-2020 (Cohort 1)	**631**	**83.8%**	**70.5%**	**3.14**
All Other First-Year Students	595	83.8%	69.8%	3.15
Women Student Success Program	19	89.5%	89.5%	3.53
Multicultural Student Success Program	17	88.2%	82.4%	2.75

2020-2021 (Cohort 2)	**669**	**76.8%**	**67.7%**	**2.93**
All Other First-Year Students	628	76.1%	67.0%	2.91
Women Student Success Program	21	95.2%	95.2%	3.61
Multicultural Student Success Program	20	90.0%	85.0%	3.25
2021-2022 (Cohort 3)	**842**	**79.6%**	**68.6%**	**3.06**
All Other First-Year Students	808	79.2%	68.3%	3.04
Women Student Success Program	18	88.9%	77.8%	3.58
Multicultural Student Success Program	16	87.5%	75.0%	3.18

Looking across the three academic years it is clear that the freshman to sophomore retention rates to the university and to the engineering college, are generally higher for Cohort 1 as compared to Cohorts 2 and 3. Approximately 84% and 71% of students were retained to the university and engineering college between freshman and sophomore year for Cohort 1 (AY 2019-2020) compared to only 77% and 68% for Cohort 2 (AY 2020-2021). Retention rates are higher for Cohort 3 (AY 2021-2022) compared to Cohort 2 (80% and 69%) but still not as high as for Cohort 1. Similarly, cumulative GPA is higher for Cohort 1 (3.14) compared to Cohort 2 and Cohort 3 (2.93 and 3.06) with Cohort 3 fairing slightly better than Cohort 2.

When comparing first-year students who participate in the URM student success programs to other students in the college, we can see that among every cohort, first-year students involved in the women student success program have the highest cumulative GPA and the highest retention rates to the university and the engineering college compared to all other students. First-year students in the multicultural student success program in AY 2019-2020 have lower cumulative GPAs, but similar retention rates to peers not in student success programs in the same cohort. Students in the multicultural student success programs in cohorts 2 and 3 have comparable or higher cumulative GPAs compared to peers not in student success programs, but their retention rates are much higher than student peers in their cohort who did not participate in a student success program.

Few conclusions can be drawn about the impact of the COVID-19 pandemic looking at these descriptive statistics. The patterns we see may be random or simply not associated with COVID-19. Nevertheless, we do know that there were unique and pervasive challenges and disruptions that impacted first-year students in different ways based on the timing of their college entrance. It is interesting to note that the AY 2020-2021 cohort experienced the most disruptions due to COVID-19 preventative measures, and this cohort has the largest inequities between first-year students who participated in student success programs and students who did not. Students in the women and multicultural student success programs who were first-year students in AY 2020-2021 had the highest cumulative GPAs of any of the cohorts studied. There is a similar trend for retention rates; students from cohort 2 who belonged to student success programs had far higher retention rates to the university (95% and 90%) and the engineering college (95% and 85%) than students in student success programs in the other two cohorts. This is in sharp contrast to students who were not in student success programs in the three cohorts. First-year students in AY 2020-2021 who did not participate in academic student success programs had markedly lower

retention rates and cumulative GPAs than their non-participating peers, with the most striking difference in AY 2019-2020 in particular. Additionally, first-year students in cohort 2 who did not participate in student success programs have the lowest cumulative GPA of any other group.

Qualitative Results

From the thematic analysis of the interviews several consistent and clustered themes emerged across the three cohorts of first-year engineering students due to the impact of the COVID-19 pandemic. First, students indicated that the university's pandemic policies and virtual learning opportunities acted as major obstacles in their efforts to connect formally and informally with peers and faculty in classes, hurting them academically and socially. Second, students discussed how pandemic restrictions impacted their learning and engagement in classrooms due to the lowered expectations of hybrid learning. The COVID-19 pandemic also limited student opportunities to connect socially in informal settings outside of classrooms. Finally, students discussed both the challenges of the remote success programs but also the benefits they felt they provided compared to students who did not have the benefit of virtual cohort-based affinity group programming.

These themes are outlined below. Quotes from interviews were edited for word repetition, false or unintentional starts, and extraneous phrases (e.g., like, um, I mean, well). In some instances, an ellipsis was used to denote a sentence or phrase that had been cut for the sake of clarity—without objectively changing the original intent of the statement.

Missed Classroom Connections

Students in Cohort 1 were able to build some social connections in their first year that likely helped to sustain them during the social isolation they likely experience in their sophomore year. However, some still mentioned they felt that their social capital had been stunted during the 2020-2021 academic year.

> *I think that I was able to connect actually with a lot of really good people that have managed to stay in my life. So, I'm really grateful for that. Yeah, I think I was able to get involved enough in my first semester of my freshman year that the social aspect [of COVID-19 restrictions] wasn't necessarily a barrier for me. (Cohort 1)*

> *For the semesters I've been here it's been great. Yeah, because like a freshman year second semester we all got sent home like that's when COVID happened. And I came back for sophomore year first semester, but I went back [home] second semester, because like all my classes were online. And nothing was really going on on-campus, so I decided to save some money and just stay home instead. But the other two semesters I was here, it was really good. Yeah and this semester has been good, so far, so yeah. (Cohort 1)*

Students within Cohort 1 and 2 presented mixed feelings about who they felt they could connect within the virtual educational setting. Some expressed that, due to their inability to make peer

connections within the new learning environment, they felt that their only resources within the class were the instructors. One student reported that, “the only person I could ask for help was from a professor or TA rather than a fellow student.” (Cohort 1)

> *The wall that they put up between students and professors, it’s so hard to work with your professors to be the best it can be, [that] would probably be my toughest [academic] challenge. (Cohort 1)*

One student described the difference between online breakout rooms for connecting with classroom peers.

> *And socially, I guess it’s kind of, it’s just kind of hard because when you talk to your classmates in breakout rooms, it’s just for that time, but you don’t really get to have like small talk when you go to class and like get to really know them. So socially, I would say that was a struggle. (Cohort 2)*

As a result, some students felt a notable discomfort when returning to the physical campus without any established social connections. One student expanded on how the pandemic changed their mindset about social interactions:

> *I kind of changed my mindset about social interactions and how that kind of fit into college because now coming back after COVID I find it really hard to like balance school and social life. Because like I was used to not having to worry about it at all. And so that's been really interesting, but I know that I really want to take advantage of the social life, and so it's kind of hard to have to like balance that. (Cohort 1)*

Consistently throughout the interviews, students within Cohort 2 expressed a disconnect between what they had hoped for their first-year social interactions and what had actually occurred. As another student expressed it, the inability to make friends or socialize led them to feel that they were “never really introduced to that student life” (Cohort 2) that they anticipated when entering college.

> *This year of college, particularly, has been difficult for me. I think as much as everyone else, COVID ruined a lot of the freshman experience that I thought that I would be having. (Cohort 2)*

> *We had the same ideas of what we wanted from college socially and stuff, and that we wanted to meet new people. We wanted to get out there, but it was really hard. (Cohort 2)*

Learning Challenges

In the case of the classroom setting, a well-established social environment, students encountered the harsh limitations of hybrid learning. Multiple students discussed their inability to properly function or engage in a learning environment that was devoid of social interaction:

> *My first semester, I was able to have in- person and online. So I guess I got to experience a little bit, but generally just understanding the hybrid format and*

motivation to go to my Zoom meetings, because some of them were like, attendance is not mandatory, and I could just sleep in and just watch the lectures later and just stuff like that. (Cohort 2)

Challenges with COVID would be studying habits. My studying habits increased tremendously. So, coming back to in-person and now I have to study a lot more than I'm used to because one- tests are now timed again. Before, all of mine were, "Here's an exam, I'm going to put it up. Don't use any resources. Just turn it in when you're done." And they give you six hours to do it. Now I have to do the same amount of work in two hours, and I'm not used to that. (Cohort 1)

It was made clear, however, that these issues extended beyond just the virtual learning environments. Hybrid students indicated that new COVID-19 policies were also actively hindering their peer interactions within the physical classroom as well. One such student had this to say:

Whenever I had in-person classes, or like for chemistry labs, it's kind of hard to communicate and socialize with other people, considering you're both wearing masks and with COVID restrictions and having places to go it gets really hectic and hard to communicate. (Cohort 2)

This inability to effectively communicate not only limited peer-to-peer discussion, it also hindered the development of social capital (connections with peers) that otherwise would have been supportive of learning within the course. In some instances, this meant limited opportunities to conduct group work or projects. In other cases, it meant that they lacked a reference group of peers who are also studying in engineering and so they ultimately felt like they were struggling alone.

It really made it hard to get help with projects or talk to people and be like, hey, I'm having an issue, like maybe you're having the same, or like just feel like you're part of a group. I felt like I was really alone in my classes, even though most of my sophomore classes were optional and you could go in-person. So, them like saying that and saying like, okay, you like, don't talk to your classmates about coding, and then Covid-19 on top of that was really isolating, and like, okay, well, I don't know anybody. I don't know what's going on. I feel like I'm the only one who doesn't know what's going on. And it had this bad effect of just totally draining your mental health in that way. (Cohort 2)

I feel like engineering probably has one of the hardest workloads and so some of the other people who I have met, they may be in their rooms, a lot, but they also don't have as much work to do. I feel like that is something that I've struggled with this year is being motivated to keep up with the work of engineering when I'm just kind of by myself. (Cohort 2)

Issues with social disconnection were not limited solely to peer relationships in the classroom. Multiple students made a point to describe the disconnect they felt between themselves and their instructors. As a member of Cohort 2 described, it was difficult to "get as close with your professors". Students expressed concerns that in their larger lecture courses or virtual classes they would rarely get the type of response they anticipated from their instructors. In many instances, students were not able to develop a relationship with the instructor and it was not lost on the students what implications this may have for their futures. As one stated:

> *I had the same chemistry professor both first and second semester, and I never met him in person. So, it's definitely a lot harder to make those connections with professors. And just kind of thinking forward to being able to have letters of recommendation and stuff like that, I feel like a lot of freshmen kind of were not able to make a lot of those connections. (Cohort 2)*

When it came to reports of social isolation (in formal classrooms or outside of class) Cohort 3 had far fewer substantial concerns compared to the other two cohorts. Several students acknowledged that pandemic procedures had effectively been limiting their opportunities for social interactions, but also pointed out that said limitations were gradually becoming less of a concern. As one student described it:

> *I guess with Covid it's been harder to meet up with people and stuff like that, because, especially at the beginning of Covid it was like don't meet up with anyone, don't do anything, and I'm a very social person, so I need that. So, luckily, I've been able to do that more recently, and starting to really get at the end of things, and Covid, by the time this year rolled around, it seems like it wasn't as bad as last year, because I can actually go to my classes, I can go to study groups, and it seems like they weren't able to last semester. (Cohort 3)*

Other students expressed that while policies in themselves were becoming less and less of an obstacle, the potential exposure to COVID-19 still served as a major barrier with respect to developing new social capital:

> *I'd say that I don't hang with a lot of people. When I see a lot of people and they're not wearing masks, I get a little a little scared a little concerned. So that's one of the biggest things. (Cohort 3)*

Students expressed that as a result of their own personal experiences, or the lived experiences of their peers, they began to foster a concern towards catching and spreading the virus. Some indicated the concern extended to their families who they were afraid might eventually contract the virus from them, and so they limited their social interactions out of caution for vulnerable family members.

> *I feel like college -- especially living in the dorms – it is a germ factory here. So, I was really stressed at the beginning of the year about like I was worried that like if I got Covid I wouldn't realize it and bring it home. (Cohort 3)*

Less Extracurricular Involvement

While attending remotely directly limited students' involvement with the physical campus, students in Cohorts 1 and 2 felt there were limitations in connecting with the campus community through extracurricular activities. Some felt "it was a little bit hard to join clubs" due to their limited connection with the campus outside of class. Others echoed this thought in stating that they were unsure how to "get involved within the school" when they didn't know what clubs or resources were accessible to them under the pandemic policies. Some students in Cohort 1 felt that missing social opportunities their sophomore year set them back even as COVID restrictions were coming to an end at the start of their junior year.

> *Socially, well, with COVID it's been hard to join things like clubs and get up into leadership positions because if you didn't join a club freshmen year, you can't join a club sophomore year because you can't attend the meetings. And then now facing junior year, you have to be in a club for a year before you can be in leadership. So, I can't be in a leadership position because I haven't been in club. (Cohort 1)*

> *Honestly, one thing I kind of wanted to do but didn't really do is like finding clubs. I just didn't really know how to find that many or just seeing like what I could get involved in within the school. It could have been me like I just didn't put that much effort into it, but also, I think COVID did play a part. Because if [more classes were] were in-person I could have branched out, talked to more people. (Cohort 2)*

Members of Cohort 3 similarly expressed limitations in their ability to develop social capital through extracurricular opportunities; however, their concerns focused on the limitations enforced on clubs as a result of the university policies that were left over from the previous year. As one student described it:

> *The biggest change or consequence would have to be with clubs and when you're meeting in like what size of clubs, you can have together and doors, and if you can have food. So that's probably been the biggest conflict point, but I wouldn't be aware of that, if I wasn't on [redacted club] and having to plan these events. (Cohort 3)*

This led to a reoccurring theme of students being eager to participate in organized group activities that were unfortunately limited in size or occurrence. For one student, this meant it was slightly more of a hassle to organize in-person meetings:

> *I created this group called [redacted] at [redacted] and with COVID-19, the school has restricted some guidelines; since there is like at least 23 members in the group we can't have a meeting over the limit of 20, so, we've kind of closed that off, so now if we would like to have a meeting, we have to inform the school and let them know. (Cohort 3)*

For another student belonging to an club/organization, this meant gathering off-campus in unrestricted sizes that posed the risk of disease contraction, an outcome that eventually happened:

> *We'd go from house to house, which would just be really packed and there's always kind of that fear of "Okay, if one of us gets COVID how's this going to go?" And then December hit and January and I got COVID in January and it kind of went through everyone and so. (Cohort 3)*

Peer Connections in Success Programs

Across all three cohorts, students expressed a common theme that their involvement in URM gender and race/ethnic minority success programs supported them in developing social capital even in the midst of the COVID-19 pandemic. Twenty-five interviewees indicated that participating in said programs assisted them in their goals of connecting with peers and forming new friendships. As one student stated:

> *[redacted program] has definitely helped me to just make those connections that are going to be very crucial later on into my degree. (Cohort 3)*

Several acknowledged that the meetings and arranged events planned by the success programs acted as an "opportunity to make connections easily" (Cohort 3). Others also felt it important to express that this ease in establishing connections partially came from the commonalities in the gathered student groups. Two participants in the multicultural student success program had this to say:

> *They're all just like enthusiastic and it was nice to see other people that were in the same majors. Because, like normally I feel like in classes you don't really like talk to people that much. Unless you're forced to. Like there, it was more like people would just talk because they wanted to like get to know each other, so that's pretty cool.* (Cohort 1)

> *The [redacted] program is great for having a small group of close-knitted engineers that strive within the same goals as you. And the diversity within the program is amazing, and it allows you to create new relationships with your peers as well as your advisor. Mine is [redacted name] and she's an incredible advisor. She helps us through any problems that we have within college and it's really great speaking with her as well as my other peers in [redacted] program. It's a really great bonding experience, I would say. (Cohort 2)*

Still, the pandemic changed how the program was offered to each of the three cohorts at some point during the pandemic.

> *I know we still had class in-person, for most weeks. So I guess that was good, but it was definitely … we still had to all be six feet apart and wearing masks and [redacted program leader] would even say: "Oh well, we would try to do a group activity for this, but guess we're not." So I feel like definitely a lot of*

those group building activities kind of go by the wayside with COVID because you're not supposed to be close to people and then zoom is really weird for trying to do group activities so that hasn't been the greatest. (Cohort 2)

While I think they normally do more events, it has been a little hindered this year. So I would say that and since there has been limited meet ups in-person, I like … I know everybody in the group, but not very well and I think that if there were more in-person things I would get to know them a little bit better, my peers and stuff. (Cohort 2)

Despite the programs having to be modified, the connections formed remotely were sometimes the only connections students were able to make:

So this year was kind of hard, with it being a pandemic and all... I don't feel like people's normal advice going into college was necessarily as applicable this year, and it was just very, very different especially when I didn't know very many people. So then when you're coming in, I have a lot of questions and not a lot of people to ask which is why I really appreciated being in the [redacted program] because we had mentors there that I could reach out to and ask questions. (Cohort 2)

Discussion and Conclusions

It is important to note that during the pandemic, institutional resources and expectations were focused on supporting the classroom experience for students. Overall, less priority and resources were devoted to academic success programs, cohort-building, and extracurricular groups. It is is also important to note that while success programs are intended to provide students academic support and skill development to aid in academic and professional development and success, the ability for each of the programs to deliver that goal may be overshadowed by the value of cohort building and network development. It is difficult to differentiate skill, personal, and professional development from the value of being included in a supportive cohort or accessing a functional network.

The COVID-19 pandemic was not what our research group had originally set out to study. Nevertheless, we found the student stories of hardship and resilience during a formative transition of their life inspiring. Our findings reinforce prior work in non-pandemic times about the positive impacts of cohort-based affinity group programs on the academic success and social capital of their participants. It further suggests that these impacts were magnified during the pandemic because students who were not participating in these programs were denied the social and academic interactions that occur in the course of a normal academic year at a residential four-year university. Additionally, our study suggests that when done properly, online experiences can be used to help students build relationships and social capital even though they are not fully equivalent to in-person programs. A hybrid approach to offering students cohort-based affinity groups may allow these programs to efficiently scale to more first year students and to further broaden participation in engineering.

The long-term impact of COVID-19 on student learning and mental health is still unknown, particularly for students who were just beginning to build foundations for mathematics, science and other core subjects. Future research should continue to follow students who experienced the pandemic in order to understand how they as individuals and through programs are building social capital and academic subject matter expertise. Longer term research should also look at the career trajectories and professional success of students who experienced the pandemic during the later years of high school or early years of college due to the critical timing of that transition and its importance from a life course perspective [36], [37].

Acknowledgments
This work was supported by the U.S. National Science Foundation through grant 1848696. The opinions expressed are those of the authors and do not necessarily represent those of the NSF. The authors wish to thank the participants of the interviews and student success program staff including Jennifer Skidmore, Emily Griffin Overocker, Alma Ramirez-Rodgers, Jayde McWilliams, Eric Einspahr, and Paul Breitkreutz.

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Appendix: Interview protocol

Interview Questionnaire

1. (Ice breaker) When you were a kid in elementary or middle school, what did you want to do for work when you grew up?

2. When you were younger, did you always know you would go to college?
   - If Yes – how did you know?
   -If No – How old were you when you knew you would go to college? What made you think you should go?

3. When you were applying to college, can you think of any resource that was particularly helpful to you in the application process? (prompts: A resource can be a person, place, institution, or critical piece of information) Were there any specific resources available to you when you were applying to college that made the process more easy or coherent? If so, please describe.
   a. How many colleges did you apply to?
   b. How did you decide where to apply?
4. When did you know you wanted to go into engineering?
   a. Have you ever considered any other majors outside of engineering?
   b. What have been the major factors that you think have influenced you into going into engineering?
   c. How likely, if at all, are you to switch majors out of the college of engineering?
5. Switching gears a little bit, can you speak to how the current COVID-19 pandemic has affected your college experience or involvement in (URM program name) over the past year if at all?
6. Aside from COVID-19, in general, how has your college experience been so far?
   a. What have been some of your biggest challenges academically?
   b. What have been some of your biggest challenges socially?
   c. Have you had anything else happen in college overall that was challenging?
7. Please Describe any successes you have had in college?
   a. What type of resources have helped you succeed?
   b. In what ways do you see yourself succeeding as your college career progresses? *What opportunities and resources are available to you that will increase your success later in your college career? What opportunities or resources could be made available that would increase your success?*
8. Are you involved in any student organizations? Y/N
   a. If Y – What are they?
   b. If N – Why not?
   c. Are any in the college of engineering?
9. Can you describe the support services that are available to you:

10. Describe any experiences you have had with success coaching
11. Are there any support services that you wish you had access to that your program doesn't currently offer? Please describe.

Now I have a few questions about the (URM student success program) specifically.

12. If you were going to tell a friend about (URM ssp), what would you tell them?
13. Tell me about how you first learned about (URM ssp)
14. what made you decide to participate.
15. In what ways, if any, has your involvement in (URM ssp) helped you?
16. How often you have attended events for (URM ssp)?
    a. What is the biggest barrier to you attending?
    b. Is there any incentive we could provide that would motivate you to attend more events or programming?
17. Is there anything you think (URM ssp) should do differently to get more students involved? Are there any services you wished they provided?

Wrap-up questions

1. In what semester did you declare engineering as your major?
2. Are you part of, or working with, any other organizations related to engineering? (e.g., internships or employed in the field).
3. Are you currently employed, if so how many hours a week do you work and where?