Social Capital During COVID-19: Research Case Studies from U.S. and U.K. Contexts

Jameka Wiggins (Graduate Researcher)

Originally from Prince George's County, Jameka Wiggins is a Ph.D. student in Engineering Education at The Ohio State University. She started her Ph.D. in the Fall 2021 after earning her bachelor's degree in Chemical Engineering and minor in Entrepreneurship and Innovation at the University of Maryland, Baltimore County (UMBC). Jameka has always had a passion for service and an interest in helping to support marginalized populations in STEM, specifically engineering. In addition to being a doctoral, she loves to spend time with her bichon poodle mix Cairo, family, and friends!

Amanda Johnston

Amanda Johnston is a lecturer at California Polytechnic State University, San Luis Obispo.

Kerrie A Douglas (Assistant Professor of Engineering Education)

Dr. Kerrie Douglas, Assistant Professor of Engineering Education at Purdue, studies how to improve the quality of classroom assessments and evaluation of online learning in a variety of engineering education contexts. She holds a PhD in Educational Psychology and a M.A. in Educational Studies, with focus on school counseling. She is a co-PI on the SCALE project, leading the evaluation and assessment efforts. She recently received an NSF award to study engineering instructor decisions and student support during COVID-19 and impact the pandemic is having on engineering students. She also recently won the prestigious CAREER award from the U.S. National Science Foundation to study increasing the fairness of engineering assessments. In total, she has been on the leadership of more than $24 million dollars in research awards. Her research on evaluation of online learning (supported by two NSF awards #1544259,1935683,) has resulted in more than 20 peer-reviewed conference and journal publications related to engineering learners in online courses. She was a FutureLearn Research Fellow from 2017-2019; a 2018 recipient of the FIE New Faculty Fellow Award and was the 2021 Program Chair for the Educational Research Methods Division of ASEE.

Julie Martin

Julie P. Martin is a Fellow of ASEE and an associate professor of Engineering Education at The Ohio State University. Julie's professional mission is to create environments that elevate and expand the research community. She is the editor-in-chief of Journal of Women and Minorities in Science and Engineering, where her vision is to create a culture of constructive peer review in academic publishing. Julie is a former NSF program director for engineering education and frequently works with faculty to help them write proposals and navigate the proposal preparation and grant management processes. She was a 2009 NSF CAREER awardee for her work operationalizing social capital for engineering education. More recently, Julie has encouraged the engineering education research community to embrace methodological activism, a paradigm whereby researchers intentionally choose methods for the political purpose of empowering marginalized populations. Learn more about her research team, Elevate, at juliepmartin.com.

Ines Direito (Dr)

Social Capital During COVID-19: Research Case Studies from U.S. and U.K. Contexts

Abstract

Our research used a case study methodology to explore how engineering students at a university in the United Kingdom and in the United States experienced social supports in the spring term(s) of 2020 when universities worldwide shifted into emergency remote teaching due to the COVID-19 pandemic. To the best of our knowledge, this is the first cross-cultural study to examine engineering students' social support during the pandemic. We administered the Undergraduate Support Survey to engineering undergraduates at both institutions. The survey collected data about students' sense of belonging and social capital, including names of individuals who provided support for their engineering education and the specific expressive and instrumental resources they utilized during the pandemic.

Results revealed similarities and differences between students at the two institutions. Both groups reported friends/roommates, professors, and family members as the primary providers of support, and both reported almost the same frequency in communication with these individuals. Participants at both institutions also reported high rates of instrumental and expressive support. However, the mean response for both sense of belonging and satisfaction at the university was lower in the U.K. and the types of alters identified in the two groups showed marked differences. Our work affirms the importance of social relationships to engineering students' success and persistence.

Introduction and Literature Review

College students' social interactions fundamentally changed in March of 2020 when the COVID-19 pandemic forced universities worldwide to shift to emergency remote teaching (ERT). Student's relationships were no longer based on frequent, in-person interacts with members of the campus community. Face-to-face classes and co-curricular activities on campuses halted and students faced changes in living situations as they sheltered-in-place with family or friends [1], [2].

The changes in social interactions caused by the pandemic are concerning to educators because these interactions are important for learning. Learning is a social activity and social interactions are necessary to develop deep understandings of new and complex ideas [3]–[6]. Engineering students frequently rely on classroom-based social interactions such as asking classmates and instructors questions and working on team projects to develop technical and non-technical professional skills [7]. Social interactions that occur in co-curricular activities are another source of learning for engineering students, particularly for important non-technical professional skills [8].

Changes in social interactions caused by the pandemic are also concerning because they provide emotional support and access to academic resources. Interactions with faculty, staff, peers, family, and others offer emotional supports through interactions such as encouragement and normalizing struggles and tangible resources such as suggesting courses to take and providing insight into academic and connecting students to job opportunities [9]. While the pandemic negatively affected students' mental health and wellbeing overall [1], [10]–[13], students reported that social relationships positively contributed to their wellbeing during the pandemic [11], [14].

The purpose of this paper is to examine how undergraduate engineering students from two different global contexts utilized social capital during some of the most uncertain time points in the pandemic. Insights gained from a deep dive into these cases can serve to better prepare engineering educators for future educational disruptions. Our study expands on existing literature which examines students' social supports during the pandemic (e.g., [11]) by investigating the social capital of engineering students during the period of ERT in the spring of 2020 in two cultural contexts: students attending an institution in the United Kingdom and one in the United States. The overarching research question addressed is: *How were students at two institutions supported by their social capital networks during ERT?*

Theoretical Framework
Social capital theory explains the importance of using social connections and social relations in achieving goals [15]. It has been used in engineering education research to study undergraduate students' initial decisions to major in engineering, their persistence, and perceptions of fit in the field [16]. The network theory of social capital [15] describes two main types of interactions or support—instrumental and expressive—which help individuals to achieve their goals. For engineering students, instrumental support comes in the form of specific help with academic goals, such as help on a homework problem or referral to an internship opportunity. Expressive support relates to "physical health, mental health, and life satisfaction" [15 p. 244], such as emotional encouragement to persist. In social capital theory, the people in an individual's social networks are called "alters"—these are the people who provide instrumental and expressive supports through social interactions. Previous research examining engineering students' social supports during the COVID-19 pandemic has focused primarily on singular cultural context [11], and thus the current cross-cultural analysis offers significant new insights.

Methods
We employed a multiple case study approach to examine two cases during the period of emergency remote teaching [17]. Case studies are a particularly advantageous when the researchers seek to study a phenomenon in which the researcher has little to no control. Case studies allow researchers to ask how and why questions and triangulate them through several sources of data. One case was in the United States and one was in the United Kingdom. Both cases represent large research universities and focused on engineering students across multiple grade levels. The cases were chosen based on access to data in a timely manner, as suggested by Yin [17].

Case 1: United States Context

Case 1 consisted of engineering students at a large public research institution in the midwestern United States that offers a wide range of engineering majors and has a large international population with students from 112 countries. The total number of undergraduates study engineering was 10,226 at the time of the research. Approximately 51% of engineering enrollment identifies as domestic White, 12% as domestic Asian, 24% as international, 5% as Hispanic/Latinx, and 4% two or more races, with less than 1% of students identifying as African American. Approximately 74% of the engineering students identify as male. (The institution does not provide non-binary gender as an option in its data-gathering.) Prior to March 2020, the university had some infrastructure to transition courses online, but most instructors had no experience teaching virtually. All instructors at the university had a single week in which to transition to fully online learning in March, and classes were taught online through the remainder of the Spring term and campus housing was shuttered.

In Fall 2020, the university held classes both residentially and online, and students were allowed to live in campus housing. The administration emphasized the importance of residential education. Individual departments and instructors made decisions based on considerations of safety and the particulars of each course while seeking to get students back on campus. For example, large classes were primarily taught online, whereas smaller classes were held in large classrooms to enable social distancing. The first-year engineering program established many online social events to facilitate students building connections with each other. Additionally, first year engineering courses were taught online, but students were still placed in teams for design projects. Instructors utilized technology such as breakout room features on the videoconferencing application and other social platforms to encourage discourse. The university has formal programing to connect engineering students with their advisors. Advisors held a mixture of online and in-person office hours. University staff reached out to online enrolled students and online faculty on a weekly basis to provide resources and encouragement. In addition, student clubs and professional societies were allowed to meet in person with social distancing measures in place. The university provided mental health and wellness support through a number of programs administered through the campus recreation center, counseling services, and student affairs.

Case 2: United Kingdom Context
Case 2 consisted of engineering students at one of the largest research-intensive universities in the U.K. It is also one of the most international, with staff and students from over 120 countries. The engineering faculty is organized in academic departments covering a wide range of disciplines. At the time of data collection, the institution enrolled 2,952 undergraduate engineering students.

In recent years, the school's engineering faculty has undertaken a critical review and reform of the curriculum for the majority of its undergraduate engineering programs, aiming to create more opportunities for students to apply technical and theoretical engineering knowledge through practical application [18], mostly through interdisciplinary project- and problem-based learning.

Like the U.S. institution, the U.K. university suspended all in-person teaching in March and announced a fully online curriculum throughout the remainder of the academic year. The change to ERT in mid-March came about two weeks before the end of the second term of the academic

year. The third term, running from late April to mid-June, is almost exclusively dedicated to exams and final-year assessment. Hence, assessment and how to deliver the end-of year exams remotely were priorities of the ERT period.

The university has dedicated structures and resources to support student well-being (mental, social and physical), including information and advice on wellbeing and mental health (including student psychological and counselling services), dedicated support for students with disabilities, dedicated support for international students, finance and housing, and career guidance. Each of the university's academic departments has student advisors who act as key contacts for first-year undergraduates for well-being, support, and student experience matters.

Data Collection
We obtained ethics board approval from each university before any data collection was conducted at that institution. We collected data at both institutions during the period of emergency remote teaching after March 2020 using the Understanding Student Supports survey [11], which consists of three parts. Part 1 includes questions that are designed to elicit information about students' sense of belonging and satisfaction at the university using a Likert scale response of 1 to 5 [19]. The students were asked to select their level of agreement with the following statements:
Sense of Belonging:
- I feel connected to the University community.
- I feel I am member of the campus community
- I feel a sense of belonging with the campus community.

Satisfaction:
- I'm satisfied with my educational experiences this semester.
- I'm satisfied with the amount of social opportunities I've had this semester.
- I am glad I chose to attend the University this semester.
- I think the University has done a good job of continuing quality instruction during the time of the COVID-19 pandemic.

Part two consists of a name generator [16] in which students were asked to list the names of up to five people whom they considered to be influential to their success and persistence in engineering. After naming each person, respondents were then prompted to answer several questions about each person they named, including (1) the nature of their relationship, (2) how long they had known the person, and (3) how that person had supported them that semester. The third part consisted of a resource generator [16] in which lists several types of support, asking respondents to identify the types of alters (such as family members or peers) that provided that support both before and during the periods of ERT.

We administered the survey at both institutions within the same time frame relative to the start of the semester. Because the U.S. institution was substantially larger, we recruited a random sample of engineering students from that institution without an incentive and recruited with an incentive of $20 GBP from the population at the U.K. institution. After data cleaning, the resulting sample consisted of 336 engineering student participants from the U.S. institution and 138 participants

from the U.K. institution. Due to constraints placed by the U.K. institutional ethics board, demographic information of race, ethnicity, and gender were not collected from that site.

Data Analysis

To clean the data, we first eliminated any responses with an unreasonably short response time. This resulted in negligible amounts of missing data in the Likert section. In the name generator section, the survey asked respondents to list up to five people who supported them during the COVID-19 pandemic and gave "N/A" (not applicable) as an option; we cleaned this section by removing all responses that did not include the name of at least one alter. Additionally, we removed a participant's entire response if they did not indicate a legitimate alter type within the name generator response section. For example, a few participants listed a celebrity as an alter, which does not meet the definition of an alter from social capital theory because the participant does not have a personal relationship with that person.

After the initial data cleaning, we categorized the data from the name generator based on the alter type. We refined these categories through an iterative process involving discussions with all authors. We created 12 categories from initial participant responses. In **Table _1_. Categorized Alter Types**Table 1, we document how we created our final categories.

Table 1. Categorized Alter Types

Final alter type	Sample responses included in alter type
Advisor	Academic, department-specific, and co-curricular advisor
Extracurricular personnel	Band advisor, robotics club advisor, athletic coach, those who facilitated co-curricular or program specific activities
Family	Parent, stepparent, uncle, aunt, grandparent, sibling
Friend/roommate	Roommate, best friend, friend, fraternity brother
Mentor	Success coach, peer mentor, assigned department-specific mentor, co-curricular activity mentor
Professor	Professor in named course, professor (course not named), lecturer, instructor, teacher
Significant other	Boyfriend, girlfriend, fiancé, spouse
Spiritual/medical guide	Religious personnel (such as pastor), medical doctor (such as therapist)
Supervisor/employer	Future employer, manager, academic supervisor
Teaching assistant	TA, lab assistant, module lead, research graduate student, graduate student
University staff/personnel	Administrator, program-specific staff, general university department representative
University student staff/personnel	Student counselor, residential assistant, tutor

After the data was cleaned and categorized, we used descriptive statistics and graphical representations to visualize the results for each case. For the Likert scale data, we separated the questions designed to elicit information about sense of belonging and questions designed to elicit information about satisfaction. We used descriptive statistics to analyze students' responses to each of the questions.

We worked to ensure high quality data analysis in several ways. First, we worked on the data analysis in an iterative process. For example, two authors lead the categorization of the name

generator, but, if there were any responses that did not fall neatly into a category, they consulted with the rest of the team to ensure correct understanding of the student's response. Additionally, our author team consists of researchers working in each of the different cultural contexts, ensuring that we are accurately understanding the student responses from their cultural background.

Results

In this section, we present the results for each case, followed by a comparative investigation across cases to look for similarities and differences in student responses across cases. Case Study 1 is the U.S. institution and Case Study 2 is the U.K. institution. There were total of 336 responses for the U.S. case and 138 responses for the U.K. case.

Sense of Belonging and Satisfaction

We separately analyzed Likert scale responses for sense of belonging questions and satisfaction questions. For the U.S. case, the mean response for sense of belonging was 3.38 (*SD* = 1.08) and the mean response for satisfaction at the university was 3.33 (*SD* = 1.05). For the U.K. case, the mean response for sense of belonging was 2.92 (*SD* = 1.00) and the mean response for satisfaction at the university was 2.94 (*SD* = 0.96).

Name Generator

Figure 1 shows a summary of the results from the name generator section of the survey. There were twelve categories defined in the U.S. case study.

As shown in Figures 1 and 2, the alters who offered the most support to students during the pandemic were the same in both countries: friend/roommate, professor, and family member.
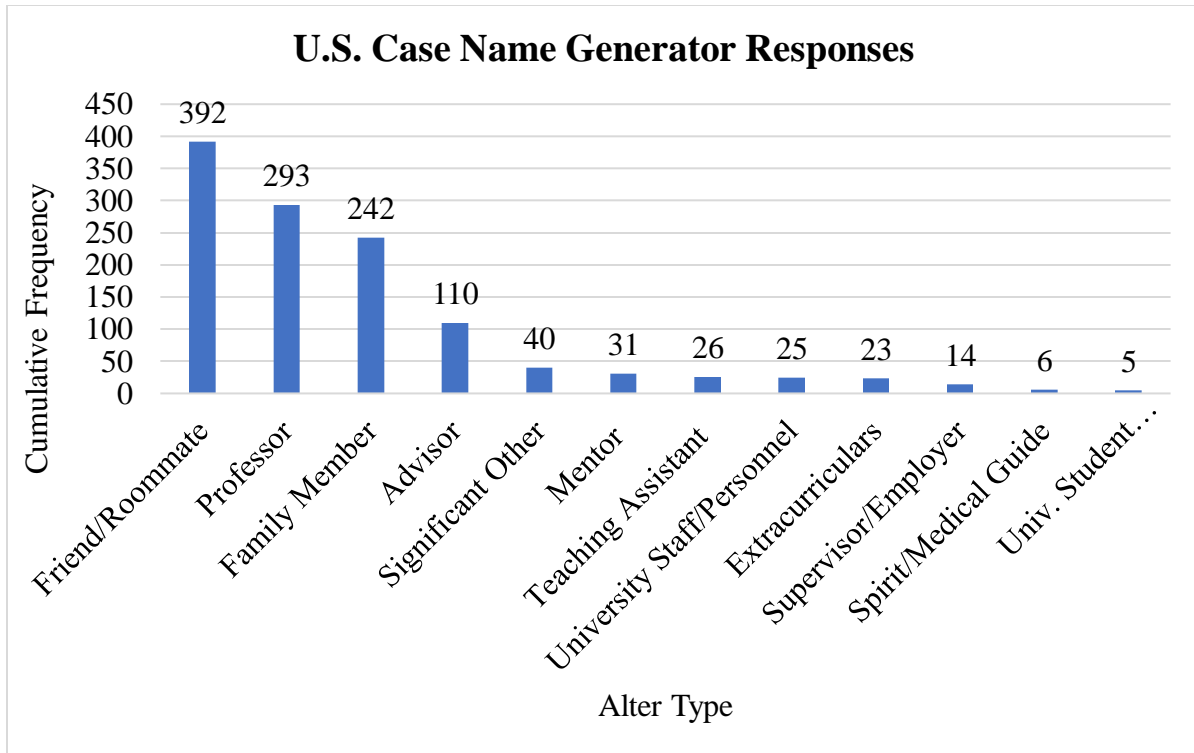
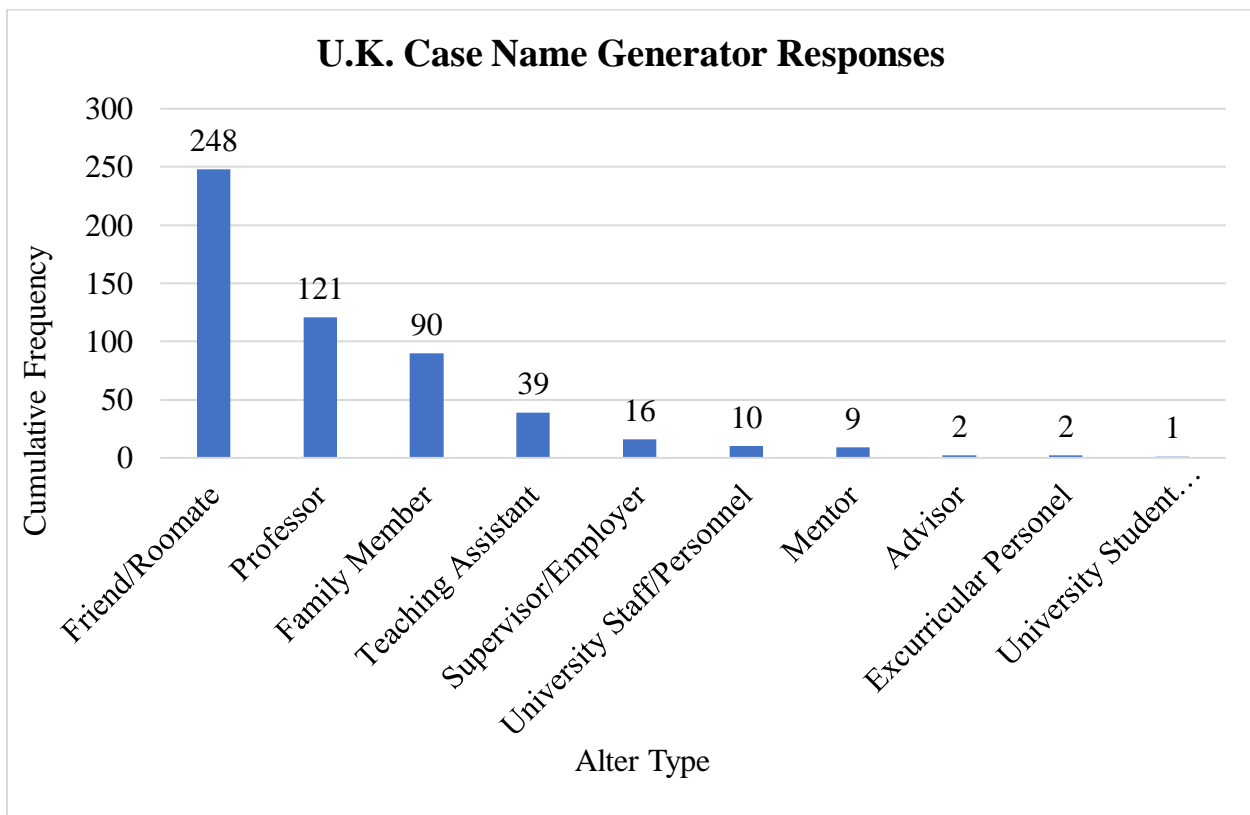Figure 1: Frequency of alter types identified by respondents in the U.S. case study.

Figure 2: Frequency of alter types identified by respondents in U.K. case study

Next, the survey asked participants several questions about each alter they listed. For example, students were asked if the person was affiliated with the university. The results are displayed in

Table *2*, which displays the percentage of students who identified an alter with each level of communication frequency. For the U.S. case, 73.4% of the alters identified in the name generator were affiliated with the university and in the U.K. case 73.1% were affiliated with the university. Students were also asked about their frequency of communication with the alters they identified. For example, 4% of students in the US case identified an alter in their top five with which they almost never communicated. The higher percentages of results in the more frequent communicates indicate that students rely more heavily on alters with whom they communicate more frequently and that the rates are similar across the two cases.

Table 2. Students Report of Communication with Alters. Table displays the percentage of students who identified an alter with each level of communication frequency.

Frequency of communication with alters	U.S. case responses	U.K. case responses
Almost never	4%	6%
Once a year or less	2%	2%
A couple times per year	10%	12%
Monthly	7%	7%
A couple times a month	9%	9%
Weekly	12%	14%
A couple times per week	22%	15%
Daily	16%	18%
More than once per day	18%	17%

The survey also asked students to identify the types of support that each alter in the name generator provided during the period of ERT. Table 3 displays the results of the supports by alter for the top two alter types, professors and friends/peers. Percentages are the percentage of alters identified in the name generator that students identified as providing each type of support.

Table 3. Supports Provided by Top Two Alter Types. For the U.S. case, a total of 293 alters were identified across all student responses and for the U.K. case, a total of 121 alters were identified.

Support	Professors		Friends	
	Case 1: U.S.	Case 2: U.K.	Case 1: U.S.	Case 2: U.K.
	Expressive: Wellbeing			
Your mental or emotional health	20%	10%	72%	54%
Your physical health	9%	6%	60%	38%
Disappointments you've had	19%	11%	67%	52%
Difficulties you've faced	35%	12%	75%	58%
Encouraged you to keep going when you struggled	0%	12%	72%	58%
Asked about your levels of stress	0%	12%	47%	52%
	Expressive: Mentorship and Advice			
Challenge me to be my personal best	65%	39%	67%	65%
Checks on my progress	47%	28%	59%	50%
Discusses school, academic and career topics	60%	38%	76%	65%
Encourages me about my studies	63%	36%	67%	55%
Is a mentor	41%	24%	15%	11%
Supports me with other resources.	43%	22%	65%	40%
	Instrumental			
Helps me with course selection	18%	13%	30%	31%
Suggests networking opportunities	32%	12%	23%	22%
Tries to involve me in extracurricular activities	15%	7%	49%	36%
Gives me advice on academic and/or career options	56%	18%	50%	34%
Suggests job or graduate school opportunities	33%	13%	21%	25%
Introduces me to people in their professional network	19%	9%	17%	17%

As seen in Table 3, students at both universities identified high rates of support in both expressive and instrumental supports from both their professors and their friends. For the professors, these rates were highest in the expressive (mentorship and advice category). Although the rates were lower for the other categories identified, they still suggest that professors were providing a wide range of expressive and instrumental supports during the pandemic to their students. The rates of support from friends were distributed across all types of supports, suggesting that students received a wide range of supports from their friends. This was especially true for expressive supports.

Cross Case Comparison and Discussion

Belonging and Satisfaction: The student responses to the questions about sense of belonging and satisfaction differed between the two cases. In the Likert scale questions, students in the U.K. case indicated lower mean responses for both sense of belonging and satisfaction at the university. This could indicate that that the supports in place at the U.S. institution helped students feel a stronger sense of belonging.

Alter Types: We found several key similarities in the types of alters students identified between the two cases. In both the U.K. case and the U.S. case considered their friends to be most important for their success and persistence. This is not surprising, as college age students often rely heavily on their peers and their peers play an important role in their development from students to professionals [11], [14]. However, there was reason to be concerned that the isolation created by the pandemic would prevent students from having a support system of their peers. The next most identified group was their professors and then family members. The percentage of close alters that were affiliated with the university was almost exactly the same across the two cases. This indicates that differences between the two cases had little impact on the alter types students relied upon in each.

On the other hand, among alters less important than the top three, there were some key differences between students in the two contexts. In the U.S. context, university-based advisors were indicated by many students (110 total responses) as providing support. However, there were only two responses indicating advisor alters in the U.K. context. This could indicate that advisors at the U.S.-based institution did more to support students during ERT, that students had stronger relationships with their advisor in the U.S. context, or that advisors had a more central role in students' educations in the U.S. context. This indicates a difference in how advisors are viewed and utilized in the different cultural contexts. Additionally, there were several groups of alters that were indicated by the U.S. students that were not mentioned by the U.K. students, including spiritual guides and therapists, university staff, and romantic partners. This could indicate cultural differences in how students approach support and the people they turn to for support or it could point to institutional differences in how students were expected to interact with their these groups.

Interactions with Alters: We noted similarities in the frequency with which participants in each case interacted with the alters (

Table *2*). Students in both cases relied most heavily on alters with whom they had frequent interactions. This suggests the importance of close ties with alters to develop relationships and have consistent support [15]. It also provides evidence that students were able

to maintain these relationships during the period of ERT, even when they were physically separated from their alters.

We also found that students at both institutions relied on each of the alter types for a wide variety of types of support. For example, professors in both contexts provided both expressive and instrumental support. In fact, they most heavily supported students in expressive support in mentorship and advice. This shows that even though professors were more isolated from students and had fewer one-on-one interactions with them, professors still provided a wide range of these essential supports. Additionally, friends in both cases provided high levels of supports in each of the three categories, expressive supports (well-being and mentorship/advice), and instrumental. This supports the importance of peer-peer relationships and demonstrates that students continued these supports even when they were more isolated. This provides insights into the resiliency of students' social networks and demonstrates that students continued to nurture these relationships, even when physical distance created challenges. We saw slightly lower values for all types of support in the U.K. context. This could indicate that students did not maintain as close relationships with their close alters during the period of ERT.

Summary

In this study, we examined the social capital and supports students received at two different institutions, one in the U.S. and one in the U.K., during the period of emergency remote teaching due to the COVID-19 pandemic. We surveyed students across the engineering schools at both institutions about their sense of belonging and satisfaction and used a name generator to ask them to identity the top five people in their social networks and the types of supports these people provided. We found many similarities and several key differences across the two cases. Similarities included: students identified the same top three groups of alters, friends, professors, and family members; students identified that individuals in each of these groups provided them with a range of instrumental and expressive supports—even though they were physically isolated from these alters. Students relied on university alters and non-university alters at almost exactly the same rates at the two institutions. We also found some differences. These differences included: students in the U.S. case identified some groups of alters, such as advisors and extracurricular personnel, more frequently than the U.K. case; and students in the U.S. case identified on average a higher sense of belonging at their university.

Conclusion and Implications

From our findings, we conclude that despite the many challenges caused by the global pandemic, engineering students at the two universities studied found ample support. For example, we expected that the close ties associated with family would provide students with many supports, and our data supported this assumption.

What is somewhat more surprising—and promising—is that professors played an important role in supporting students during this time of crisis. Their support was not limited to purely academic-related issues; they also provided salient emotional support that helped students succeed. This finding has implications for helping students during crises and during "business as normal." If faculty recognize their potential to positively influence a students' academic journey through expressive actions such as inquiring about their stress levels, sharing their own disappointments and difficulties while earning an engineering degree, or encouraging students who are facing obstacles, individual faculty could support student success and collectively

faculty could even begin to change the stress culture for which engineering programs are widely known.

Our findings also point to the essential relationships that students have with peers—relationships that provide a variety of instrumental and expressive supports those students report as being influential to their success and persistence. While aspects of these peer relationships are obviously out of the control of some university personnel to a great degree, engineering faculty, staff, and students themselves have a role to play in promoting peer relationships in engineering programs. This could take the form of instructors embedding ample opportunities for teamwork in courses or advisers and co-curricular leaders promoting the benefits of out-of-class opportunities to get to know other students. Undergraduate students who recognize their significant role in the lives of their peers might take an extra minute to talk with a classmate after class or invite a friend to join them at a meeting of a student organization.

Overall, our work affirms the importance of social relationships in the experiences of engineering students. These relationships have perhaps never been more important than during the global crisis caused by the COVID-19 virus. Our findings hold implications for other events that might disrupt students' social networks, such as natural disasters. Even if face-to-face interactions are not possible, campus personnel and peers can continue to provide expressive and instrumental support that students feel are so important to their success and persistence in engineering.

References

[1]   E. Kohls, S. Baldofski, R. Moeller, S. L. Klemm, and C. Rummel-Kluge, "Mental Health, Social and Emotional Well-Being, and Perceived Burdens of University Students During COVID-19 Pandemic Lockdown in Germany," *Frontiers in Psychiatry*, vol. 12, Apr. 2021, doi: 10.3389/fpsyt.2021.643957.

[2]   J. M. Vaterlaus, T. Shaffer, and L. Pulsipher, "College student interpersonal and institutional relationships during the COVID-19 pandemic: A qualitative exploratory study," *Social Science Journal*, 2021, doi: 10.1080/03623319.2021.1949553.

[3]   S. J. Hausfather, "Vygotsky and schooling: Creating a social context for learning," *Action in Teacher Education*, vol. 18, no. 2, pp. 1–10, 1996, doi: 10.1080/01626620.1996.10462828.

[4]   L. Vygotsky, *Mind and Society*. Harvard University Press, 1978.

[5]   L. Vygotsky, *Thought and Language*. Cambridge, MA: The MIT Press, 1986.

[6]   A. S. Palincsar, "Social constructivist perspectives on teaching and learning," *Annual Review of Psychology*, vol. 49, pp. 345–375, 1998, doi: 10.1146/annurev.psych.49.1.345.

[7]   N. Cross and A. Clayburn Cross, "Observations of teamwork and social processes in design," *Design Studies*, vol. 16, no. 2, pp. 143–170, 1995, doi: 10.1016/0142-694X(94)00007-Z.

[8]   S. Garrett. J. P. Martin. S.G. Adams, "Developing nontechnical professional skills in African American engineering majors through co-curricular activities," *IEEE Transactions on Education*. 2021. doi: https://doi.org/10.1109/TE.2021.3120210

[9]   J. P. Martin, S. K. Stefl, L. W. Cain, A. L. Pfirman, "Understanding first-generation undergraduate engineering students' entry and persistence through social capital theory," *International Journal of STEM Education*, vol. 7, no.1, pp. 1-22, 2022. doi: https://doi.org/10.1186/s40594-020-00237-0

[10]   The Healthy Minds Network and American College Health Association, "The impact of COVID-19 on college student well-being," pp. 1–11, 2020, [Online]. Available: https://www.acha.org/documents/ncha/Healthy_Minds_NCHA_COVID_Survey_Report_FINAL.pdf

[11]   K. A. Douglas, A. C Johnston, J. P. Martin, T. Short, T., & R.A. Soto-Pérez. "How engineering instructors supported students during emergency remote instruction: A case comparison." *Computer Applications in Engineering Education*, 2022. doi: 10.1002/cae.22495

[12]   I. Chirikov, K. M. Soria, B. Horgos, and D. Jones-White, "Undergraduate and Graduate Students' Mental Health During the COVID-19 Pandemic," 2020. [Online]. Available: https://escholarship.org/uc/item/80k5d5hw

[13]   Y. Zhai and X. Du, "Addressing collegiate mental health amid COVID-19 pandemic," *Psychiatry Research*, vol. 288. Elsevier Ireland Ltd, Jun. 01, 2020. doi: 10.1016/j.psychres.2020.113003.

[14]   I. Eloff, "College students' well-being during the COVID-19 pandemic: An exploratory study," *Journal of Psychology in Africa*, vol. 31, no. 3, pp. 254–260, May 2021, doi: 10.1080/14330237.2021.1939055.

[15]   N. Lin, *Social capital: A theory of social structure and action*. Cambridge University Press, 2001.

[16]   J. P. Martin, M. K. Miller & D. R. Simmons, "Exploring the theoretical social capital "deficit" of first generation college students: Implications for engineering education, "*International Journal of Engineering Educatio*n, vol. 30, no. 4, pp. 822-836, 2014.

[17]   R. K. Yin, *Case study research and applications: Design and methods*, 6th ed. Thousand Oaks, CA: SAGE Publications Inc., 2018.

[18]   Authors, "No Title," 2018.

[19]   K. A. Bollen and R. H. Hoyle, "Perceived Cohesion: A Conceptual and Empirical Examination," *Social Forces*, vol. 69, no. 2, pp. 479–504, 1990, [Online]. Available: https://academic.oup.com/sf/article/69/2/479/2232339