

COVID-19 and U.S. Higher Education: The Realities of Undergraduate International STEM Students' Experiences

Arianna Cooper

Arianna Cooper joined Florida International University in August 2021 where she is pursuing her PhD in Engineering and Computing Education. Prior to FIU, she obtained her bachelor's in Industrial and Manufacturing Engineering from her alma mater, Indiana Tech. She is from the Bahamas and has lived in the United States for six years. Her research focuses on the experiences of STEM international students who have migrated to the United States for higher education. Today, she will be presenting on COVID-19 and U.S. Higher Education: The Realities of Undergraduate International STEM Students' Experiences.

Trina L. Fletcher (Assistant Professor)

Dr. Trina L. Fletcher is an Assistant Professor of Engineering and Computing Education and a Faculty Fellow for the Division of Diversity, Equity and Inclusion (DEI) at Florida International University. Her research includes asset-based studies on women and people of color within STEM education and engineering and computing education at historically Black colleges and universities (HBCUs). Dr. Fletcher uses large-scale data sets to conduct research using mixed-methodologies focused her target populations. She is a 2022 NSF CAREER awardee for a project centered on developing a database using quantitative and qualitative longitudinal data on STEM professionals experiences beginning in K-12 to their current professional occupations. She is an elected steering committee member for EngineerGirl, the leading initiative for the National Academy of Engineering (NAE) to increase the number of girls going into engineering. Her awarded grants include NSF RFE, NSF RAPID focused on COVID-19, Department of Energy (DOE) NNSA MSI Partnership Program grant and several corporate and foundation grants. Prior to FIU, Dr. Fletcher worked in engineering and operations for two Fortune 500 companies and served as the Director of Pre-college Programs for the National Society of Black Engineers (NSBE).

COVID-19 and U.S. Higher Education: The Realities of Undergraduate International STEM Students' Experiences

WORK IN PROGRESS - STUDENT PAPER

Abstract

Higher Education is the fifth largest service export sector in the United States, with international students contributing \$17.7 billion to the U.S. economy each year. There is a plethora of reasons why students migrate to the U.S. to further their education, including but not limited to: (1) increasing their chances for long-term success and increasing self-efficacy; (2) supporting their family through educational advancement; and (3) gaining access to high quality education. Prior research highlights how international students face challenges linked to federal restrictions and policies that potentially hinder their academic success, all of which were heightened during the COVID-19 pandemic. Information such as this raises concern around the current state of undergraduate international STEM (science, technology, engineering, and mathematics) students in the U.S. and access to resources (i.e. scholarships, fellowships, internships, full-time jobs, etc.), especially compared to their domestic counterparts. This insight is particularly true for individuals seeking to obtain a degree within STEM (science, technology, engineering, and mathematics) as the U.S. serves as an incubator for STEM talent due to the abundance of workforce opportunities present. Therefore, it is important to explore the experiences of undergraduate international STEM students pursuing degrees in the U.S., especially as the COVID-19 pandemic continues to have a lingering effect within higher education. Our target population has an influential impact on the nation's economy, particularly H1-B visa sponsored jobs at top companies within the technology sector driving a large portion of our growth within the STEM workforce. This work in progress focused on qualitative analysis centered on the experience of undergraduate international STEM students. This study includes a literature review that highlights the latest findings around our target populations' experiences during the pandemic. Following that, the methods highlight our proposal to conduct a qualitative analysis including interviews with current students. The methods section closes with a draft of the interview questions which center around their experiences, barriers and challenges they face (past and present) related to the pandemic and information related to access to resources. Lastly, an overview of the proposed impact, implications of this study once complete and overarching conclusions. The goal is to get feedback from the broader ASEE community, finalized the interview protocol, conduct the interviews, analyze, and share results and use the overall findings to propose new directions and future work for the broader community.

Introduction

Higher Education is the fifth largest service export sector in the United States, with international students contributing \$17.7 billion to the U.S. economy each year [1]. Hence, the United States is the leading destination for international students compared to other countries such as China, Australia, Canada, France, etc. [20]. There are a plethora of reasons students migrate to the U.S. to further their education, including but not limited to: (1) increasing their chances for long-term success such as better employment opportunities and increased self-efficacy [21]; (2) supporting their family through educational advancement by improving their

standard of living [21]; and (3) gaining access to higher quality education and their families recognize the labor-market value of obtaining foreign qualifications [21].

Although other countries may be attracting international students, the United States keeps its competitive edge because of its workforce [11]. In fact, this is particularly true for individuals seeking to obtain a degree within a STEM (science, technology, engineering, and mathematics) field. Interestingly, the enrollment of international students in STEM programs fosters more domestic students to acquire these degrees [25]. In other words, international students are making STEM degrees more appealing to U.S. students, and Higher Education is witnessing double enrollment in these programs because of the positive relationship [25]. The United States is an incubator for STEM talent and success because of the abundance of opportunities. For example, international students can apply for Optional Practical Training after graduation to gain relevant work experience for one year, and extensions are available for STEM majors [2].

Despite these great opportunities for international students and the United States as a whole, research has shown little regard to the theme of equity and access for these students. Quite often, conversations surrounding equity and access frame the conversation from a U.S. domestic student perspective. For example, according to McGill et al. [18], "One element of that work is the development of inclusive and equitable UREs for students from underrepresented groups—communities historically excluded due to structural barriers in U.S. higher education." Many papers focus on first-generation and minority students; however, they fail to consider an international student's global perspective, which alters their identity compared to domestic students. For the United States to remain competitive, it must continue carrying a "welcoming" factor toward international students, including acceptance and seamless integration into the U.S. community and campus culture for this group of students [2]. To influence a smooth U.S. cultural adjustment for students from other countries, they should be included in the conversation and research is a vital component around ensuring their experience is equitable like their domestic counterparts.

Unfortunately, most funding agencies such as The National Science Foundation do not perform research to examine international students, only domestic students. In return, it portrays a message that this demographic of students is not seen as a priority when research shows the influence international students can have on encouraging their domestic counterparts to pursue STEM degrees [10][25].

This research will begin to unpack themes of equity concerning this vital student population, international students. In particular, the focus of this paper will be on STEM fields due to their global competitiveness [19]. What is the extant literature on the experiences of international STEM students in U.S. post-secondary institutions, particularly from an equity and access viewpoint?

Literature Review

Who are undergraduate international STEM students?

The term “international student” usually is interchangeable with foreign-born students. According to Le & Gardener [16], an international student is “A person who is not a citizen, national, or permanent resident of the U.S. and who is in this country on a visa or temporary basis and does not have right to remain indefinitely.” The most prominent international students in the U.S. migrated from Asia [2]. Often students move to the United States to pursue STEM degrees; Han et al. [14] shows us this is evident because “one third of science and engineering post-graduate students in the U.S. are foreign born.” International student enrollment trends are increasing in the United States with a steady growth of 6% each year since the 2011-2012 academic year [5].

Challenges faced by undergraduate international STEM students pre-COVID

After 9/11, the terrorist attack, the circumstances changed in the United States for international students studying in the United States [2]. Ultimately, the tragedy placed international students in the spotlight. As a result, stricter procedures and policies were established on student visas [2]. For example, the Student and Exchange Visitor Information System modified its operations’ services, the universities’ altered their enrollment procedures, ultimately impacting the international students they serve [2]. New visa regulations made it hard for international students to understand the United States system to maintain status [2]. In like manner, international students were now expected to maintain their grades and visa status to remain eligible to study in the US. For this reason, officials have stepped up by supplying support in navigating visa policies and obstacles for this student population [2].

Lack of Funding Opportunities

Özturgut [18] recognized the most promising U.S. institutions with the most significant number of international students on their campuses. In the article, Özturgut [18] used the Open Doors report to explain how most international students in the United States are funded through personal and family sources, accounting for 70% of primary funding originating from outside the United States. This data has sparked conversations on recruitment and retainment efforts for U.S. universities. Bound [4] emphasized how the substantial declines in state backing for U.S. public universities have resulted in universities increasing tuition levels, lessening expenses, and even enrolling more out-of-state students to benefit from the increased tuition. International students are the targeted audiences for universities to recruit as they provide a stream of tuition revenue. Unfortunately, Özturgut [18] implied that only 30% of international students could find financial assistance in the United States to offset out-of-state tuition.

Challenges faced by undergraduate international STEM students during COVID

Qianqian Zhang-Wu [26] is an assistant professor of English and Director of Multilingual Writing at Northeastern University who believes in the importance of supporting international students’ academic, language, and cultural adjustment through literacy instruction. The onset of the COVID-19 pandemic involved racism and xenophobia as well as policies and visa

restrictions created a sense of urgency to support students from culturally and linguistically diverse backgrounds. In 2019, the Institute of International Education reported over 1 million international students enrolled in the U.S. and Chinese students represented the largest group. International students are commonly seen as threats to national security in the U.S., linguistically incompetent however these students have boosted the economy; for example, in 2018, more than \$45 million were added to the economy due to international students. Unfortunately, one reason international students are not supported on an institutional level is the lack of prepared faculty members to effectively support these students from a cultural and linguistic perspective. With the sudden effects of the COVID-19 pandemic such as, “sudden dormitory closures and the transition to online learning” has caused challenges associated with remote learning and socioemotional wellbeing. Dr. Zhang-Wu [26] proposed several solutions to aid in helping international students amid the global crisis with the goal of classrooms serving as an environment for community building, empowerment, and care. The first suggestion was to have smaller class size with 20 students max to ensure that students are receiving individualized learning, give international students the room to grow, increase cultural and linguistic diversity and use writing as a healing exercise.

Government Decisions and International Students during COVID

At the early onset of the pandemic, government leaders around the world had to make decisions around entering and exiting their countries. In the U.S., strict restrictions and polices came down to stop the rising flow of the virus. Included in this process were rules and restrictions linked explicitly to international students enrolled in higher education programs [13]. For example, in the U.S., where online education was already in place within most schools and colleges on campus pre-COVID and most institutions had to go 100% online, international students, at this same time, were not allowed to live in the U.S. on their visas while taking all online courses. It was required as of Fall 2020 that they had to be taking at least one in-person class to stay on campus. These abrupt transitions to online learning along with the unprecedented restrictions placed on domestic (i.e., not being able to go to campus) and international students, led to a decline in enrollment within STEM programs, and overall engagement of students. Wester et. al. [24] found a major decline in emotional engagement, declines in attitudes towards science, specifically, and the overall negative impact that the pandemic had on students' ability to engage within these courses.

What can the United States do to support international students?

Research shows that international students declare several challenges that they encounter in the United States, such as (1) lack of diversity in coursework and research interest; (2) the quality of courses; (3) faculty turnover rate; (4) lack of funding and economics; (5) exams; (6) new culture adjustments; (7) new educational system; (8) separation from family, friends, and country; and (9) English proficiency requirements [16]. Programs for International Students should compensate for international student challenges, Burt et al. [6] suggest that university administrators start to ease the transition to the U.S. for this group of international students by orientation programmatic activities/resources. Programmatic activities can help some international students adjust to their new homes [17]. Interestingly, the study showed that international students have a higher chance of making friends with the other nine international

students because they share similar experiences and challenges, such as adjusting to cultural differences.

In some cases, international students can find it easier to assimilate to American culture as a means of “blending in” [17]. In contrast, others hold firm to their culture by minimizing interactions with American peers [17]. With this in mind, it is essential to create programs to help students build a community and sense of belonging without neglecting their connection to their unique culture and identity. Additionally, Lin [17] discovered that international students could use withdrawal as a negative survival mechanism to avoid being a victim of discrimination or experiencing rejection (p.8). As a result, it would be a disservice to place the experiences of international students under the same umbrella as domestic students’ experiences. Indeed, Burt et al. [6] highly recommends institutional leaders to fully grasp the labels “foreign-born” or “international” to ensure all complexities of their identity are being captured when intending to be served to avoid further marginalization [6].

There is no guarantee that international students can stay in the United States post-graduation. Hence other countries are looking more inclusive due to relaxed immigration policies (Han et al., 2015). Immigration policies hinder the United States’ ability to retain international STEM-focused students after graduation [23]. Forty-three percent of global STEM doctoral students expressed interest in remaining in the United States post-graduation [23]. The U.S. remains the top destination for international students; however, this country is not retaining talented foreign-born after graduation [23]. The issuance of H-1B visas would help make their desires a reality [23]. Given what has been discovered in the literature for our target population, this study will be guided by the following research questions: *What are the experiences of undergraduate international STEM students during the COVID-19 pandemic?*

Methods

This core of research study is centered around a qualitative inquiry into undergraduate international STEM students' experiences during the COVID-19 pandemic. Below is a list of preliminary questions that will be used as a part of the interview protocol. The questions will be broken down into five (5) areas: demographic, general experiences, impact on academics, work experiences and long-term goals post degree. The target population will be undergraduate international STEM students currently enrolled at a large minority serving institution within the southeast region of the United States. As we continue to work on this study, we will consider adding undergraduate international STEM students who dropped out of college during the pandemic to see if they would be willing to complete an interview with us as well. The prospective interviewees can be at any level within their undergraduate degree.

Section	Question
Section #1	Demographic Questions (5 Total)
	(1) What college do you attend? (2) What year are you in college? (3) What degree are you pursuing? (4) How do you identify from a gender perspective?

	(5) Which country did you migrate from before coming to the United States?
Section #2	General Experiences (5 Total)
	(1) What motivated you to study in the United States? (2) Before the pandemic, how was your experience in the United States? (3) Explain the impact of the pandemic on your experience in the United States? (4) How did the pandemic impact your living situation? (5) What types of resources did your institution provide?
Section #3	Impact on Academics (5 Total)
	(1) How was the transition to online learning during the pandemic? (2) What was one of your most challenging experiences academically during the pandemic? (3) During the pandemic, did you ever think about leaving your academic program and why? (4) How has the pandemic shaped your learning experience overall? (5) Describe a positive academic experience that occurred during the pandemic?
Section #4	Work Experiences (Internships or Full-time) (3 Total)
	(1) What has been your experience with searching for internships or full-time jobs? (2) How has the interview process been for you? (3) What resources provided by the university have been useful in your job search?
Section #5	Long-term goals post degree (4 Total)
	(1) What were your plans after college before the pandemic? (2) What are your plans now after graduation? (3) What are your parents' perspectives on your future goals pre and post pandemic? (4) What is your back plan if the job search does not turn out how you envisioned?

Impact and Implications of this Research

The contributions to the economy by international STEM graduates who complete their degrees and stay within the U.S. to fill open positions cannot be ignored. Most of engineering and computing roles in the tech sector along with every other industry that has increasing demands for engineering and computing experts rely on international students to achieve their organizational goals, the everyday needs and demands of everyday people. Whether it is hardware purchased from local stores or Amazon (i.e. televisions, phones, computers) that are designed and repaired or software that is needed to allow those devices to run, without these populations continued access into U.S. STEM degree programs, the nation's rank, reputation and safety could be at stake. Given these important notes, it is imperative that we better understand how the pandemic has impacted their interest and eventual persistence to completing their degrees. While we do not want to lose site of the importance of broadening participation for U.S. born students within these academic programs, the current pipeline shows that a decline in international STEM students receiving degrees could lead to short to long term implications for the U.S. workforce.

Conclusion

As illustrated in this paper, continuing research is being conducted about the international student experience in the United States. As can be seen, international students represent different student groups and their experiences based on their migration. It was hard to effectively tell the story of international students without separating their various identities, such as Asian international students, compared to Black male international students. Research has shown that the tragic event on September 11, 2001, influenced policy changes toward international students and affected the outlook for equity and access to these students in specific spaces. There are still opportunities present for foreign-born students; however, research suggests that work permittance limits students' post-graduation due to visa regulations. Also, STEM (science, technology, engineering, and technology) careers are booming, and international students are taking advantage of that field. Finally, the recruitment of international students should be a more holistic approach as far as having a supplemental retention plan for each student. Students new to the United States should be provided more support during their transitional period, which depends on each student. Some suggested initiatives that would combat the challenges experienced by international students are: (1) orientation programmatic activities/resources; (2) institutional leaders should fully grasp the labels “foreign-born” or “international” to ensure all complexities of their identity; (3) reanalyze immigration policies for students who would like to work in the U.S. post graduation. Given these points, there is active research taking place for this demographic of students. For future studies, it would be great to dissect the extant literature on the experiences of international STEM students in U.S. post-secondary institutions, particularly from an equity and access viewpoint more.

References

- [1] Baah, D et al., "Towards Chemical Engineering Student Diversity: The Case of International Student Experiences at Tuskegee University.," *Chemical Engineering Education*, no. 52(2), pp. 152-160, 2018.
- [2] Bhandari, R., & Blumenthal, P., *International students and global mobility in higher education: National trends and new directions*, Palgrave Macmillan, 2010.
- [3] Blake, H., Brown, N., Follette, C., Morgan, J., & Yu, H., "Black, indigenous, people of color, and international students: experiences and resolutions beyond COVID-19," *American Journal of Public Health*, no. 111(3), pp. 384-386, 2021.
- [4] Bound, J., Braga, B., Khanna, G., & Turner, S., "A Passage to America: University funding and International students," *National Bureau of Economic Research*, 2016.
- [5] Burrell, J. O., Fleming, L., Fredericks, A. C., & Moore, "Domestic and international student matters: The college experiences of Black Males majoring Engineering at an HBCU," *Journal of Negro Education*, no. 84(1), pp. 40-55, 2015.
- [6] Burt, B. A., Knight, A., & Robeson, J., "Racializing Experiences of Foreign-born and ethnically diverse Black Male Engineering Graduate Students: Implications for student affairs practice, policy and research," *Journal of International Students*, no. 7(4), pp. 925-943, 2017.
- [7] Chow, P., & Bhandari, R., "Trends in Science and Technology Study Abroad from Open Doors," *Institute of International Education*, 2009.
- [8] Contreras-Aguirre, H., & Gonzalez Y Gonzalez, E., "Experiences of International Female Students in U.S. graduate programs," *College Student Journal*, no. 51(1), pp. 33-46, 2017.
- [9] D. Dutta, "Sustaining liminality: Experiences and negotiations of international females in U.S. engineering graduate programs," *Social Science Premium Collection*, 2012.
- [10] R. B. Freeman, "Fellowship Stipend Support and the Supply of Science and Engineering Students: NSF Graduate Research Fellowships," *American Economic Review*, no. 95(2), pp. 61-65, 2005.
- [11] Galama, T., & Hosek, J., "U.S. competitiveness in science and technology," *Rand Corporation*, 2008.
- [12] Goodwin, C. D., & Nacht, M., "Fondness and frustration: The Impact of American Higher Education on Foreign Students with Special Reference to the Case of Brazil," *Institute of International Education*, 1984.
- [13] Greenland, S., Saleem, M., Misra, R., & Bhatia, B., "Measuring COVID-19's impact on international HE students and intervention satisfaction: implications for marketing theory and practice," *Journal of Marketing for Higher Education*, pp. 1-28, 2021.

- [14] Han, X., & Appelbaum, R. P., "Will they stay or will they go? International STEM Students are up for grabs," *Ewing Marion Kauffman Foundation*, 2016.
- [15] Komura, K., "Boaderless STEM education: A study of both American students and foreign students," *Social Science Premium Collection*, 2013.
- [16] Le, T., & Gardner, S. K., "Understanding the Doctoral Experience of Asian International Students in the Science, Technology, Engineering and Mathematics (STEM) fields: An Exploration of One Institutional Context," *Journal of College Student Development*, no. 51(3), pp. 252-264, 2010.
- [17] Lin, M., "Students of different minds: Bridging the gaps of international students studying in the US," *ERIC - US- China Education Review*, pp. 333-344, 2012.
- [18] Ozturgut, O., "Best practices in recruiting and retaining international students in the US.," *Current Issues in Education*, no. 16(2), 2013.
- [19] McGill et al., "You are welcome here: A practical guide to diversity, equity, and inclusion for undergraduates embarking on an ecological research experience.," *Ecology and Evolution*, no. 11(8), pp. 3636-3645, 2021.
- [20] Palmer, R. T., Maramba, D. C., & Dancy, T. E., "A Qualitative Investigation of Factors Promoting the Retention and Persistence of Students of Colors in STEM," *The Journal of Negro Education*, no. 80(4), pp. 491-504, 2011.
- [21] I. o. I. Education, "Project Atlas - The Power of International Education," [Online]. Available: <https://www.iie.org/research-and-insights/Project-Atlas>. [Accessed 2009].
- [21] Riaño, Y., & Piguet, E., "International student migration," *Oxford University Press*, pp. 1-24, 2016.
- [22] James M. S. & Singer R. S., "From the NSF: The National Science Foundation's Investments in Broadening Participation in Science, Technology, Engineering, and Mathematics Education through Research and Capacity Building.," *CBE Life Sciences*, 2016.
- [23] Ugwu, D. N., & Adamuti-Trache, M., "Post-graduation plans of international science and engineering doctoral students attending U.S. universities.," *Journal of International Students*, no. 7(1), pp. 1-21, 2017.
- [24] Wester, E. R., Walsh, L. L., Arango-Caro, S., & Callis-Duehl., "Student engagement declines in STEM undergraduates during COVID-19-driven remote learning.," *Journal of Microbiology & Biology Education*, no. 22(1), 2021.
- [25] Zavodny. M., "The Impact on U.S. Men and Women in STEM Fields of Increases in International Students.," *National Foundation for American Policy*, 2021.

[26] Zhang-Wu. Q., "Teaching hybrid online college composition classes to international students during COVID-19: Equity, diversity, inclusiveness, and community building," *English Leadership Quarterly*, no. 43(2), pp. 9-13, 2020.

[27] N. -. N. S. Foundation, "About NSF - Overview," [Online]. Available: <https://www.nsf.gov/about/>.