The Journal of the Southern Association for Information Systems

Volume 9
Issue 2 *Information Systems in the Time of Covid*

Article 5

6-17-2022

Impact of COVID-19 on the Career Trajectories of Black, Indigenous, and Latinx IT Graduate Students and Professionals

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Recommended Citation

Monroe-White, T., & McGee, E. O. (2022). Impact of COVID-19 on the Career Trajectories of Black, Indigenous, and Latinx IT Graduate Students and Professionals. The Journal of the Southern Association for Information Systems, 9, 60-71. https://doi.org/doi:10.17705/3JSIS.00027

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Cover Page Footnote

This material is based upon work supported by the National Science Foundation under Grant No. 1940055. Any opinions, findings, and conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

https://doi.org/doi:10.17705/3JSIS.00027

ABSTRACT

This study utilizes an explanatory sequential mixed-methods design to examine the impact of COVID-19 on the career trajectories of information technology (I.T.) graduate students and professionals of color. Building on individual differences theory in the initial quantitative phase, data from a national survey of 356 STEM graduate students and professionals of color (Black, Indigenous, and Latino) were analyzed to investigate intersectional differences among I.T. and non-I.T. STEM graduate students and professionals by race/ethnicity, gender, and socio-economic characteristics. Findings suggest differential impacts of COVID-19 on I.T. graduate students and I.T. professionals. Among STEM graduate students, financial strain significantly affected their career plans, whereas among professionals, gender was a significant predictor. Qualitative evidence from I.T. respondents clarified quantitative findings. I.T. graduate students (n=239) were more concerned about research setbacks and career instability, while I.T. professionals (n=117) were concerned with setbacks in professional roles and networks, work/life stability, and increased desires for entrepreneurship.

Keywords

COVID-19, I.T. careers, graduate students, race, ethnicity, individual difference theory, career trajectories, interrupted doctoral education

INTRODUCTION

The COVID-19 pandemic has generated new opportunities and challenges, and heightened expectations of information technology (I.T.) solutions and workers in healthcare delivery (i.e., telehealth), work (i.e., digital, and remote), and education (i.e., online and hybrid) (Rai, 2020). However, few studies have explicitly centered on the impact of the pandemic on I.T. professionals (Arshad, 2020). The I.T. workforce social inclusion literature has demonstrated that students from marginalized populations (e.g., women of color) are less likely to enter and persist in I.T. fields (Ashcraft et al., 2016). In fact, according to 2018 Equal Employment Opportunity Employment statistics, the information and data processing sector is 87% male and 63% White, while just 9% of professionals are Black and 8% are Latino.[1] Therefore, increasing the diversity of the I.T. workforce depends in large part on recruiting and retaining Black, Latino and Indigenous master's and doctoral students and professionals with a sustained commitment to the field. By identifying how diverse groups of I.T. workers respond to and identify longstanding and now more pronounced systematic barriers in the field because of COVID-19, solutions can be framed from a perspective where race is no longer ignored within IT equity framings. Therefore, understanding the impact of this pandemic on the current and future I.T. workforce is critical. This study contributes to the social inclusion and COVID-19 literatures, by investigating the impact of the COVID-19 pandemic on the future career plans of underrepresented and minoritized (i.e., Black, Indigenous, and Latino) information technology (I.T.) graduate students and professionals.

THEORETICAL BACKGROUND

The term social inclusion has contested meaning (Gidley, et al., 2010). The term has been used to investigate macro-level issues of poverty alleviation and economic performance (Oxoby, 2009) and micro-level topics of individual identity markers (i.e., national, ethnic, gender etc.) and sense of belonging (McCrone and Bechhofer, 2008). Although there appears to be no consensus on a single definition of social inclusion, an exploration of social inclusion research within the information technologies literature reveals a robust yet emerging literature pertaining to sources of variation in I.T. career interest and persistence based on one's identity (Windeler et al., 2018). As noted by Trauth and Howcroft (2006), "[s]ocial exclusion arises from social inequalities and in every population, there are groups who remain underrepresented in the information technology profession...". Trauth's *Individual Differences Theory of Gender and I.T.*; provides a framework capable of explaining barriers and biases affecting the full participation of traditionally marginalized groups in the information technology workforce. However, this paper extends this gendered framing to include factors of race/ethnicity (Cain & Trauth, 2013) and expands the *identity* and *environmental influences* dimensions to examine the ways in which the COVID-19 pandemic and other

[1] See U.S. Equal Employment Opportunity Commission (EEOC). (2018). Job Patterns for Minorities and Women in Private Industry (EEO-1 Public Use File). [Washington, D.C.] https://www.eeoc.gov/sites/default/files/2020-10/EEO1%202018%20PUF.xlsx

structural barriers are influencing the current and future Black, Indigenous and Latino I.T. workforce (Trauth, et al., 2016). Adopting the broad definition of information technology as "the study, understanding, planning, design, construction, testing, distribution, support and operations of software, computers and computer-related systems that exist for the purpose of data, information and knowledge processing" (IF4IT, 2012), this manuscript seeks to understand the combined impact of the global pandemic and historical racism on the future career plans of Black, Indigenous and Latino I.T. professionals.

The COVID-19 literature to date has focused on the technologies that have gained rapid adoption in all aspects of the economy from virtual web conferencing and mobile tracking systems (Urbaczewski & Lee, 2020) to telehealth (Singh et al., 2020). The COVID-19 education literature has focused primarily on highlighting the opportunities and challenges associated with hard pivots to virtual instruction and e-learning (Hasan & Bao, 2020). These studies are critical for unpacking the socio-technical complexities associated with the delivery of educational content via hybrid and fully online modalities across disciplines and the globe. However, we also know from the social inclusion literature that shifts in the I.T. career and future employment landscape will not affect all organizations, workers, or individuals equally. Early career women and working parents in academia have been especially negatively affected due to the disproportionate engagement in childcare responsibilities and the history of income inequality (Fulweiler et al., 2021). Meanwhile, employees in low-paying jobs were more likely to experience unsafe working conditions (Kantamneni, 2020). In higher education, the shift to online instruction with many campus labs closed has slowed and even stagnated research, which in turn impacts students' graduation and post-graduation career plans. Likewise, STEM companies and university departments implemented hiring freezes or canceled or reduced ongoing research projects and internships (Sahu, 2020). Meanwhile, Black and Latino STEM students, faculty, and other workers persistently experience the added burden of racism and systemic marginalization (McGee, 2020). It is against this backdrop that we propose to shed light on the impact of the pandemic on the career trajectories of I.T. graduate students (Levine et al., 2021), and professionals from underrepresented and minoritized backgrounds (Forakis et al., 2020). We sought to answer the following research question: *What impact has the COVID-19 pandemic had on the current and future career trajectories of Black, Indigenous, and Latino I.T. graduates and professionals?*

METHODS

In this explanatory, sequential mixed-methods design; quantitative data are analyzed first; followed by a qualitative analysis of open-ended items to relate back to quantitative findings. In the quantitative phase, evidence from a sample of 350 STEM graduate students and professionals of color (Black, Indigenous, and Latino) were analyzed to investigate intersectional differences among I.T. and non-I.T. STEM graduate students and professionals by race/ethnicity, gender, and socio-economic characteristics. The second qualitative phase involves an exploration of quantitative insights to further explain how future career trajectories are being shaped by the pandemic.

The data for this study were collected between May 2020 and December 2020 from a broader National Science Foundation (NSF) funded study targeting STEM graduate students and alumni of color (e.g., African American/Black, American Indian/Alaska Native/Indigenous, and Latino/Hispanic) about their future career plans. The *Supporting Innovations and Diversity among Entrepreneurs (SIDE)* survey developed by the authors was administered to students and graduates funded under the National GEM Consortium (GEM). The GEM Consortium's mission is to enhance the value of the nation's human capital by increasing the participation of underrepresented groups (African American/Black, American Indian/Alaska Native/Indigenous, and Latino/Hispanic Americans) at the master's and doctoral levels in engineering and science. Respondents self-reported their primary academic sub-disciplines (i.e., cloud computing, hardware security etc.) and/or role descriptions (i.e., CTO, technology architect etc.). To operationalize this broad definition of I.T., we utilize the North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) codes to evaluate responses. The following NAICS>SIC classification codes were utilized to classify respondents studying I.T. disciplines or working in I.T. fields, including:

541512 - Computer Systems Design Services

- 7373 - Computer Integrated Systems Design (e.g., office automation computer systems integration design services; Computer systems integration design consulting services)
- 7375 - Information Retrieval Services (e.g., online or remote database information retrieval)

518210 - Data Processing, Hosting, and Related Services

- 7374 - Computer Processing and Data Preparation and Processing Services (e.g., data processing)
- 7379 - Computer Related Services, Not Elsewhere Classified (e.g., database developers, requirements analysis and computer hardware)

To avoid confusion with other closely related fields, responses from individuals for whom computer science or engineering (including software engineering, biotechnology, or nanotechnology) is their primary area of study were included in our non-I.T. STEM comparison group. However, in nascent fields, where the NAICS or SIC codes lacked sufficient detail for classification (i.e., machine learning and artificial intelligence), individuals in interdisciplinary data, information, and knowledge fields were included to reflect a range of I.T. experiences.

The survey collected demographic characteristics including age, US nativity, gender, sexual orientation, race, and socioeconomic status (SES) along with responses to our open-ended question: *In what ways, if any, have recent events related to COVID-19 influenced your current or future career plans?* Close ended response options included: a) They have not, or b) They do, please explain. Across all participants (n=356), 67% (n=239) are graduate students/post docs and 33% (n=117) are STEM professionals. Among graduate students/post docs 21% (n=49) are in I.T. fields compared to 28% (n=33) of professionals. Our survey population is also 48% female, 83% US native, 14% lesbian, gay, bisexual or transgender (LGBT), 57% have student loan debt, 24% indicate that they do NOT have enough household income to live comfortably ("Would you say your total household income is enough for your household to live comfortably?"), and 62% identify as being African-American/Black. The race/ethnicity breakdown is as follows: 62% African American or Black, 36% Latino/Hispanic, 2% American Indian/Alaska Native, and 1% Asian American (see Table 1).

	% Female	% US Native	% LGBT	% with Student Loan Debt	% not enough Household Income	% I.T. Field	% African-American/ Black	Age (mean)
Overall (n=356)	48%	83%	14%	57%	24%	23%	62%	M=31 SD=9
Grad students/post-docs (n=239)	51%	82%	19%	62%	31%	21%	56%	M= 27 SD=5.9
STEM professionals (n=117)	43%	85%	6%	47%	10%	28%	73%	M=38 SD=11

Table 1. Descriptive Statistics

QUANTITATIVE ANALYSES

A series of independent samples t-tests using the COVID-related item ("In what ways, if any, have recent events related to global pandemic influenced your current (or future) career plans?" with response options: They have (1) or They have not (0) was used as the dependent variable (DV). Data are disaggregated by graduate students/post docs and professionals suggesting that the influence of the COVID-19 pandemic differs for graduate students and professionals. Among workers, females (66%) were significantly more likely than males (40%) to indicate that the global pandemic influenced their career plans, $t(107) = 2.83$, $p = .005$. However, gender was not a significant predictor among graduate students. Instead, among graduate students, participants who do not have enough household income (58%) were significantly *more* likely than those who have enough income (41%) to indicate that

the global pandemic influenced their career plans, t(130) = 2.41, p = .017. However, household income was not a significant predictor among I.T. professionals. These findings are consistent with the overall binary logistic regression model which indicates that household income was a significant predictor of our DV. That is, participants who do not have enough household income to live comfortably were more than twice (2.04) as likely to indicate that the global pandemic influenced their career plans (see Table 2). No significant differences were found between I.T. and non-I.T. STEM students or professionals for any of our models.

Predictors	B	S.E.	Wald	Sig.	Exp(B)
I.T. Field	.16	.28	.32	.574	1.17
Female	.32	.24	1.84	.175	1.38
US Native	.25	.32	.60	.437	1.28
African American/Black	.14	.26	.32	.574	1.16
Age	.03	.02	2.99	.084	1.03
LGBT	.17	.33	.28	.598	1.19
STEM Professional	-.02	.31	.00	.958	0.98
Not enough household income	.71	.28	6.27	.012*	2.04
Student Loan Debt	-.04	.24	.02	.883	0.97
Constant	-1.62	.55	8.53	.003**	0.20

Note. 04 (Cox & Snell), .06 (Nagelkerke). Model χ^2 (9) =14.27, p=.113.

Table 2. Binary Logistic Regression of COVID-19 Impact

Disaggregating the data by graduate students/post docs and professionals suggest; however, that among graduate students, Household income was a significant predictor. That is, graduate students who do not have enough household income are over twice as likely (2.14) to be influenced by the global pandemic (Table 3).

Predictors	B	S.E.	Wald	Sig.	Exp(B)
I.T. Field	.09	.37	.06	.809	1.09
Female	-.01	.29	.00	.963	0.99
US Native	.29	.38	.59	.444	1.34
African American/Black	.15	.30	.23	.630	1.16
Age	.03	.03	.74	.388	1.03
LGBT	.10	.37	.07	.797	1.10
Not enough household income	.76	.31	6.04	.014*	2.14
Student Loan Debt	-.26	.30	.74	.388	0.77
Constant	-1.27	.88	2.06	.151	0.28

Note. 04 (Cox & Snell), .05 (Nagelkerke). Model χ2 (8) =8.61, p=.376.

Table 3. Impact of COVID-19 on Graduate Students Only

Among STEM professionals, on the other hand, gender was a significant predictor. That is, *female* STEM professionals were nearly three times (2.97) more likely than males to be influenced by the pandemic (Table 4).

Predictors	B	S.E.	Wald	Sig.	Exp(B)
I.T. Field	.27	.48	.33	.565	1.32
Female	1.09	.44	6.04	.014*	2.97
US Native	.24	.70	.11	.735	1.27
African American/Black	.15	.56	.08	.782	1.17
Age	.04	.02	2.91	.088	1.04
LGBT	1.32	.92	2.08	.149	3.75
Not enough Household income	.59	.75	.61	.434	1.80
Student Loan Debt	.48	.44	1.19	.276	1.62
Constant	-2.59	1.04	6.18	.013*	0.08

Note. .12 (Cox & Snell), .16 (Nagelkerke). Model $\chi 2$ (8) =13.28, p=.103.

Table 4. Impact of COVID-19 on STEM Professionals Only

QUALITATIVE ANALYSES

In this qualitative phase, responses between I.T. graduate students and I.T. professionals were compared in alignment with differences identified during the quantitative phase of the study. Content analysis was conducted to extract themes from participants' answers to the following open-ended question: "In what ways, if any, have recent events related to global pandemic influenced your current (or future) career plans?" Thematic coding of participants' open-ended responses involved iteratively coding for overarching themes with thick descriptions and anonymized quotes (Table 5). Only participants who reported being influenced by the pandemic were asked to elaborate on their responses. In total, 44 participants in I.T. fields reported being influenced by the pandemic; 42 further elaborated on their responses. Among the 42, 26 were graduate students in an I.T. field and 16 were I.T. working professionals.

Overarching Themes	% Overall (n=42)	Sample Quote
1. Research and/or graduation setbacks	17%	It influences plans as far as graduation time. My dissertation [research was] put on hold because of COVID and isolation.
2. Hiring freezes	17%	Some job postings have gotten canceled.
3. Professional networking challenges	17%	Business development activities are severely limited due to the inability to meet with prospective customers in person. While the potential for virtual meetings does exist, in person meetings are crucial to building the confidence and trust that is necessary in establishing the foundation for a business relationship.
4. Career/Financial Instability	17%	I wonder if I'll be financially stable, or if I'll be able to get a position of any kind.
5. Work/Life Stability	12%	Now I'd rather work somewhere that allows remote work
6. Entrepreneurial Desire	10%	Very important to develop an income separate from my job. Will be focusing on that within the next 2 years.
7. Job progression setbacks	10%	I have been skeptical to look for new opportunities in new places
Other	2%	Concerned about the responses from police officers/political leaders and lynching in certain cities.

Table 5. COVID-19 Impact on Career Trajectory Themes

Summary of Qualitative Results

Differences between I.T. graduate students and professionals emerged in the qualitative analysis validating differences observed in the quantitative phase of the study. For example, among graduate students, research setbacks, hiring freezes, and career/financial instability were the top three most common themes; among I.T. professionals, issues related to job progression, networking challenges and a desire for more work/life balance and/or independence (e.g., entrepreneurship) were the most frequent themes (Table 6).

Overarching themes	Graduate students in I.T. fields	Professionals in I.T. fields	Overall
1. Research and/or graduation setbacks	6 (23%)	1 (6%)	7 (17%)
2. Hiring freezes	5 (19%)	2 (13%)	7 (17%)
3. Professional networking challenges	4 (15%)	3 (19%)	7 (17%)
4. Career/Financial Instability	7 (27%)	--	7 (17%)
5. Work/Life Balance	2 (8%)	3 (19%)	5 (12%)
6. Entrepreneurial Desire	1 (4%)	3 (19%)	4 (10%)
7. Job progression setbacks	--	4 (25%)	4 (10%)
Other	1 (4%)	--	1 (2%)
Total	26 (100%)	16 (100%)	42 (100%)

Table 6. COVID-19 Impact on Career Trajectory by I.T. graduate students and I.T. professionals

Economic and Job Insecurity (n=14). Among minoritized graduate students, the global pandemic led to greater economic instability and job uncertainty. Furthermore, feelings of instability and uncertainty were particularly apparent among graduate students who indicated that their household income is NOT enough for them to live comfortably, exacerbating historical racial/gender barriers. Several students indicated that they were "nervous" and "concerned" about hiring freezes in academia and job postings and interviews being postponed or canceled. Martina, an African-American female, voiced uncertainty about her future as she had "job offers that were postponed due to the pandemic." Similarly, Deborah, an African-American female, describes how hiring freezes in academia have impelled her to consider pursuing industry positions:

> *"I have been more open to (more stable, better benefits) industry jobs post-graduation as opposed to strictly leaning toward the academic market."*

Research Setbacks (n=7). Another major theme that emerged among graduate students was the detrimental impact of the pandemic on their research progress. Setbacks related to their doctoral research also influenced their "graduation timing." For example, a few students indicated that delays in the IRB office and caused major disruptions to their research, which will inevitably delay their graduation. For example, Kai, an American Indian/Alaska Native male, expressed that limited access to facilities curtailed progress in his work.

> *"Set me back on my work by not being able to access facilities."*

Sarah, an African-American female describes how being forced to work remotely, coupled with IRB issues, destabilized her research plans for the foreseeable future:

> *"The pandemic has delayed activities in the IRB office and delayed me doing research. I have also been remote for 8 months and it will continue into next year."*

In fact, for Paolo, a Latino male, research setbacks caused by the pandemic were so damaging that his career trajectory has shifted:

> *"My research has been delayed and I will likely do an industry job instead of academia…"*

Networking Challenges & Business Setbacks (n=11). While research setbacks and job freezes were *not* as common among STEM professionals in I.T. fields, the pandemic seemed to have caused major impediments to their business development and job progression. In particular, for Thea, an African-American female, the ability to travel during

the pandemic and meet with potential clients and network with others in-person at conferences limited their business development activities:

> *"Business development activities are severely limited due to the inability to meet with prospective customers in person. While the potential for virtual meetings does exist, in person meetings are crucial to building the confidence and trust that is necessary in establishing the foundation for a business relationship. As a result, our business growth and profitability are dramatically hindered. Moreover, many prospective business customers (small and medium sized business) are experiencing significant business downturn and revenue losses that are preventing them from investing in incremental products and services and their associated expenses."*

For others, remote work has prevented them from seeking other job opportunities and progressing in their careers. Natasha, an African-American female participant said that remote work has deterred her from "taking on a lot of responsibility" in her job; for Diego, a Latino Male, the pandemic has dissuaded him from pursuing new opportunities and kept him "motivated to keep his current job."

Economic Independence and Work/Life Stability (n=9). Another major theme among professionals that emerged was the growing need to create more work/life stability and build their own businesses. For example, Emilio, a Latino male respondent is so pleased with remote work that he portends to leave the workforce entirely if forced to return to the office:

> *"Possibly retire once we are required to go back to work full time in the office."*

However, the desire to establish independence through entrepreneurship was particularly true for *female* professionals. For instance, Sasha and Angela two African-American female professionals in I.T. fields explained their need to establish independence as a desire to create a steady stream of income that is *not* subject to the ebb and flow of 'Corporate America.'

> *"[The pandemic] makes me want to push on developing my own business(es), so that: 1) I am not dependent on anyone else, 2) can work to develop a business(es) that can improve our community, and 3) have a business/wealth that can be passed down to my children."*

> *"I'll definitely want to build up my own business and not rely on a corporation."*

Female I.T. professionals were also likely to perceive working remotely as a refreshing change to their daily grind. Keisha and Esther, two African American females noted that working from home has given them confidence in their ability to strike a healthy work/life balance from home and within their community.

> *"Since I will be working from home for the foreseeable future and travel is restricted, I will likely relocate to be closer to my family, and to also be in a more diverse area."*

> *"Helped me to realize that a healthy balance of working from home and at the workplace, can be effective."*

CONCLUSION AND DISCUSSION

This study contributes to our understanding of the impact of the COVID-19 pandemic on the career plans of the I.T. workers, particularly Black, Indigenous, and Latino graduate students, and suggests recommendations to mitigate attrition of these future professionals from the field. There have been a number of policy innovations spurred by the pandemic adopted to address the financial strain of COVID-19 on graduate students. However, only a small fraction of graduate schools have extended funding for their students which includes health coverage, and increased eligibility and access for assistantships that cater to remote learning. To curb exit from academic pathways for these students, another approach would be to provide additional financial support for those participating in online teaching or extended assistantships from two semesters (9 months) full year (12 months) timeframes. Institutions could also encourage graduate students to reach candidacy, fund or supplement health care over the summer and winter breaks, build daycare centers for undergraduate and graduate students or subsidize daycare costs, reduce charges for online courses, and allow students to retain tuition and fee waivers while enrolled in all online courses; and offer professional development and target timelines toward dissertation progress. This suite of

recommended changes would help to shield students from future financial insecurity and research setbacks described above.

The clear and disproportionate impact of COVID-19 on women I.T. professionals also warrants more gender-centric policy innovations to meet the needs of women who often serve as caregivers to children and/or older relatives, as well as addressing income inequality for women, where minoritized women suffer the most. For example, institutional innovations should be designed to build child and senior care facilities. Likewise, flexible work and learn from home policies will likely remain an expectation of Black, Indigenous, and Latino graduate I.T. students and professionals. The pandemic has also heightened I.T. graduate students' and professionals' awareness of establishing multiple sources of income to guard against economic uncertainty. Universities can help meet this need by facilitating race and gender-conscious innovative and entrepreneurial learning at their home institutions via courses, programs, workshops, etc. specifically tailored to meet the interests of Black, Indigenous, and Latino I.T. Populations via partnerships with organizations like GEM, Black Data Processing Associates (BDPA), The PhD Project, SACNAS (Society for Advancement of Chicanos/Hispanics and Native Americans in Science), etc. This shift would help signal the legitimization and value of scholarship and entrepreneurship that harmonizes with diversity, equity, and inclusion, empowering Black, Latino, and Indigenous I.T. students. Likewise, by embracing and acknowledging the post-COVID-19 workplace landscape (i.e., one that is increasingly virtual, demographically diverse, economically varied – including dual jobholders, hybrid, and part-time entrepreneurs) institutions would strengthen recruitment and retention of these future Black, Indigenous, and Latino I.T. workers.

FUTURE DIRECTIONS

Achieving more racially inclusive graduate programs will advance the goal of racially diversifying and increasing the inclusivity of students and scholars of color; however, scholars and policymakers must still seek to better understand the impact of COVID-19 on graduate students of color—from admissions through graduation and into their careers. Ultimately, research and policy agendas should aim to understand how the pandemic and existing institutional structures hamper the retention of I.T. students and professionals and identify interventions universities can employ to alleviate disproportionate impacts on I.T. graduate students of color.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant No. 1940055. Any opinions, findings, and conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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