

Mentoring Hbcu Students through Research Assistantship in Socio-Cybersecurity. Teambuilding with Sociology and Computer Science Students

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Abstract

This paper explores the impact of role models on effective research assistant mentorships for students at Historically Black Colleges and Universities in the United States of America. The research is grounded in the role model theory, which premises that faculty-mentors can demonstrate to mentees how something is done in a technical sense. The data for this project is based on the end of year written reflections of twenty-five research assistants, as well as their conference posters and presentations. The impact of the mentor on students' progress on the development of a desktop application is also examined. The methodology was a narrative analysis of this qualitative data. The conclusion is that the role model theory is appropriate in understanding under-represented minority students' mentorship and how their mentors can be bootstrap sources for future expectations.

Keywords: Socio-Cybersecurity, Mentoring, Role Model, Qualitative Interviews

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1. Introduction

The premise of this paper is that a comprehensive STEM education for under-represented students can be achieved through mentorship. The inclusion of students at Historically Black Colleges and Universities (HBCUs) in an active socio-cybersecurity research project is a means of expanding and diversifying the field of future practitioners. The literature illustrates that HBCUs have been denied entry into American mainstream academic research. In 2014 HBCUs accounted for only 0.8 percent of all external research and development grant awards (Toldson, 2017). The exclusion of HBCUs from mainstream scholarship is most evident in the south, as most HBCUs are in the south (Hudgins, 1994). The establishment of research projects such as Socio-Cybersecurity at a HBCU in south-east Virginia is helping to address some of these educational disparities.

In our Socio-Cybersecurity project, twenty-five graduate and undergraduate students primarily from Computer Science and Sociology are included in a formal, externally funded research project. There was a deliberate process to involve students in the research agenda. Students can suspend off-campus employment with appropriate compensation and concentrate instead on paid research assistantships. The students were trained in the research process and the web application development techniques by their mentors. After Human Subjects approval,

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the students have assisted in designing and creating a web application, collecting surveys, conducting interviews, and cleaning data. A narrative analysis of students' end-of-year written reflections was used to analyze the effectiveness of the mentorship received during the research assistantships.

A critical component of the project was the students' mentorship in the design of the project's central application (the SocioCyber Desktop). The computer science professors used an experiential learning approach to guide the students in the app creation in weekly meetings. This intentional mentorship experience is also examined in this analysis from the students' perspective.

The research is grounded in the role model phenomenon, an offshoot of the reference group theory. The aim was to merge the disciplines of cybersecurity and sociology utilizing the role model theory of academic mentoring. This interdisciplinary field is called socio-cybersecurity.

2. Background

2.1 Purpose of the Socio-Cybersecurity Project

The student mentoring efforts being analyzed in this paper are situated in a larger socio-cybersecurity project. The aim of the socio-cybersecurity project is to conduct a research project analyzing how cybersecurity protocols impact employees' efficiency and performance predictability in organizations. The aim is for respondents to participate in qualitative in-depth interviews and complete an online simulated survey. Approximately one hundred and fifty employees and students from our university footprint are the targeted sample for this project. (About a third of the sample has completed the interviews at this point). Pivotal to the completion of the project is the SocioCyber Desk Application, a mock organization webspace where the respondents can interact then respond to a simulated survey. The student research assistants' role is to help the principal investigators perform this research.

2.1.1 The SocioCyber Application

The project's sociocybersecurity desktop is a made-up company app created for this project to facilitate a simulated interview methodology (Leblanc, Partington, Chapman, & Bernier, 2011). The app intentionally has several cybersecurity features which our respondents need to navigate and while using the app they will be prompted to respond to pop-up interview questions. The students were guided in building the app's database (with requirement analysis and MYSQL) by their mentor in working teams.

2.2 Theoretical Framework

The student-mentees being analyzed in this education research engaged in a formal research assistantship in a creative socio-cybersecurity empirical research project. This was guided by the Role Model theory first conceptualized by the sociologist Robert Merton. The students were all paired with a faculty mentor to complete their semester or year-long research assistantship. Robert Merton's Role Model theory emanates from the concept of reference groups. The role model is conceptualized as an individual who demonstrates how something is done in the technical sense (Hudgins, 1994). Essentially, the abstract concept of the mentor role model, is that he/she possess skills, knowledge, and techniques that the student (research assistant) lacks. This phenomenon is more than an abstraction but rather something real and

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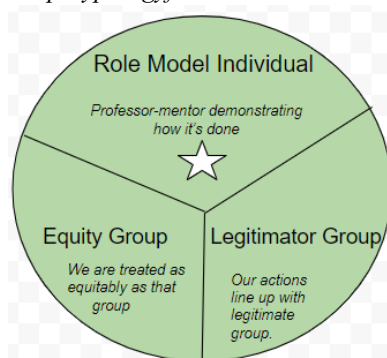
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measurable (Evans, 1992). The learning outcome from the role model/research assistant can be measured. As illustrated in Figure 1, of the top three reference groups, the role model is the only one that starts from the individual's point of view, and it appears to be the best fit for explaining the academic mentoring process.

The role model theory also suggests that mentoring is most effective in childhood and early academic life. Research assistants (both graduate and undergraduate) can be seen as synonymous with early career persons, the point at which it is hypothesized that role models are effective. "Early-stage respondents who are working on creating a viable self-concept are more likely to construe their role models as positive" (Kemper, 1968).

Figure 1: Reference Group Typology for Academic Mentoring: A Theoretical Model



2.3 Literature Review

The Socio-cybersecurity can be defined as the socio-cultural components of cybersecurity. Within this discourse, there is a focus on the social problems of the phenomenon, the socio-psychological implications, particularly for criminal justice, its role in modern bureaucracies and institutions, and on big data and research methodology. There are few justifications in the literature for conducting socio-cybersecurity research and scholarship (Turner & Turner, 2017), (Buchanan Turner & Turner, 2019), (Odlyzko, 2003) (Odlyzko, 2003). A sociological lens is appropriate in understanding the position of different groups in both shaping and responding to cybersecurity. This is true for the involved researchers and the students they mentor. Information assurance vulnerabilities can have social explanations as computer and internet systems are only as secure as their weakest link (Finnemore & Hollis, 2016); and in most scenarios, the most vulnerable links are people. The connection between socio-cultural norms and cybersecurity is the reason for the emergence of socio-cybersecurity.

Role Modeling is a well-established practice in scientific pedagogy. The existing literature indicates that representation matters. For example, having a professor with gender or ethnicity similar to the student can positively impact the interest of the student in the field (Gibson, 2003).

The literature further asserts that the concept of bootstrapping to encourage student populations like those at minority-serving institutions in succeeding in STEM disciplines is an effective tool. The role-model effect by which highly qualified professors and mentors share a common history with the students can serve as a bootstrap to their mentees (Bettinger & Long,

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2005). Therefore, the literature and the theory are relevant to analyzing the experiences of the student-research assistants in the socio-cybersecurity project.

3. Methodology

Qualitative techniques were used to analyze the data for this paper. The procedure involved analyzing the written reflections of graduate and undergraduate research assistants who worked on different stages of the socio-cybersecurity project from 2016 to 2021. Twenty-four research assistants have worked with the socio-cybersecurity project since its inception. The students were primarily from the Sociology and Computer Science departments. There were four undergraduate research assistants and three graduate research assistants from computer science, while from sociology, there were twelve undergraduate and three graduate research assistants. There was also an undergraduate research assistant from the Psychology and Interdisciplinary Studies departments, respectively. The graduate students were all pursuing master's degrees as our HBCU does not have doctoral programs in these fields.

Table 1: Demographic Description of Socio-Cybersecurity Research Assistants N=25

	Computer Science	Sociology	Other	Total
Gender	Male=4; Female=3	Male=8; Female=8	Male=0; Female=2	Male=12; Female=13
Classification	Grad= 3; Undergrad= 4	Grad= 4; Undergrad= 12	Grad= 0; Undergrad= 2	Grad= 7; Undergrad= 18
Ethnicity	African American=1; ; Asian American=1; ; International=5	African American=15; Asian American=0; International=1	African American=1; Asian American=0; International=1	African American=17; Asian American=1; International=7

In terms of demographics, the research assistantships were almost evenly distributed between males and females. Twelve of the students were male, and 11 female. Seven of the students were graduate research assistants, and seventeen were undergraduate research assistants. Finally, sixteen of the research assistants self-identified as African American, one Asian American, and six were international students (three Africans, two Caribbean, and one Asian). The sample is consistent with the population of our HBCU. The research mentees are from an HBCU in Virginia, USA. In 2020, the university had 5,457 students, 83% were African American/Black, and 67.6% were female. The full demographic detail of the project's sample is also captured in Table 1.

Six faculty mentors mentored the students. Three mentors were from the computer science department and three from the sociology department. The demographics of the faculty was, five were black and one Asian. In terms of gender, three were female and three males.

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In the first three years of the project, the students were mentored by a computer science/sociology pair of mentors. In the next two years, the four computer science students were team-mentored by a computer science faculty, and it was also discipline specific for the sociology research assistants. Once monthly, the entire socio-cybersecurity team would meet to combine their efforts.

The assessment plan of the project required each research assistant to complete a one-page reflection of their project. The reflection data has been reviewed using narrative analysis to elucidate some of the common themes and to highlight students' learning outcomes.

Secondly, the students in the project were required to attend conferences to present their findings and their experiences on the socio-cybersecurity project. The conferences were face-to-face, pre-pandemic, and virtual during COVID. The content of the posters was also analyzed to highlight the learning outcomes of our students. Twenty-three posters were presented by the students and two conference papers. The findings below represent the mentored experience of the project's research assistants.

4. Results

The students detailed the impact of the research assistant mentorship on their development. Two computer science and a sociology research assistant each said:

"Dr. XYZ was the mentor of building app who organized meeting weekly. The group members used to present regularly in the meeting and shared the unique ideas for making better project."

"My involvement in this project allowed me to learn new skills such as HTML and CSS and frameworks like Bootstrap. Additionally, I had the opportunity to collaborate and share ideas with colleagues from both departments which helped shape the face of the projects."

"I had the pleasure of working on the Socio-Cybersecurity research project alongside Sociology and Cybersecurity professors. During this time, I was blessed with the opportunity to be actively engaged in the research process and professional conferences."

The students' followed the directions of their mentors and were committed to taking ownership of the project. They could identify how the parts of the project improved their expertise in their own discipline. Two unique computer science students said:

"I worked as a Research Assistant. I contributed my whole effort to building the cyber sociology database for the app."

"In this project we build an App using different software such as My SQL, PHP, HTML etc. Dr. Turner supervised building the App. The team members used to meet weekly and share their unique ideas for making the project better."

The students even said the mentorship was effective because it concretized concepts they had covered in their curriculum. Two other students said:

I've gained exposure in the field of cybersecurity during my first semester master's degree at NSU and learned security in greater depth.

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“The best part of this project is to make people aware about cyber-attack and keep their professional and personal information secure from hackers. My role in this project is to build a socio-cybersecurity database for the app and related works.”

For computer science and cybersecurity students, the research assistantship was a effective source of mentorship. The activities in the project helped to strengthen them as computer science majors. One such student pointed out:

“I would like to thank Dr. Turner for inviting me to participate in this project. My technical skills have been strengthened by working on this project.”

Even the non-computer science student benefitted from the interdisciplinary component of the project. For example, a graduate student from the sociology department said:

“This project also made me more interested in looking at how cybersecurity affects me and the world we live in. For example, before I started working on this project, I had a general knowledge of cybersecurity like not opening unrecognized emails and having forms of antivirus on your devices to keep them safe. But I did not connect that doing simple things like that also keeps your whole network safe because if that gets breached than everyone is at risk.”

Finally, students also connected being mentored to their post-graduate expectations. One student wrote:

“In the end I hope that I get a chance to continue to work in the field of socio-cybersecurity or general cybersecurity when I graduate from university.”

There was also evidence of the students' learning outcomes from their engagement in conference presentations. Some examples of the poster the students presented were; (1) SocioCyber: A Cybersecurity Awareness in Organization Application; (2) Are Graduating Students Cybersecurity Aware; (3) Socio-Cybersecurity App Database Development; (4) The Deconstruction of Law and Order Digital Forensics Process @ Norfolk State: A Socio-Cybersecurity Analysis; among others. In addition, the students have won at least five awards for their presentations over the years.

One of the broader outcomes of this process, is that students are more likely to consider graduate studies. The research assistants have been encouraged to talk about their post-graduation plans with their mentors. The students agree that involvement in the project has had a positive impact on them.

5. Discussion and Conclusion

Based on the students' reflections, the premise of the role model paradigm is demonstrated in this project. The students pointing out that they have gained exposure is similar to the idea that a role model is supposed to demonstrate to the student how something is done in the technical sense (Hudgins, 1994). The mentorship in the technical aspects of the SocioCyber app development was effective for the computer science majors. The students pointed out that the weekly, technical project meets not only advanced the creation of the app, but it also strengthened their skills.

The literature review also substantiated the idea of bootstrapping the research assistants through mentorship (Bettinger & Long, 2005). This was also achieved through this project. The students affirmed that they were highly motivated by the mentors they were assigned to.

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Furthermore, the mentors' role was influential in them wanting to stay in the field of cybersecurity, for a job, or even for graduate studies.

It can therefore be concluded that the role model paradigm is appropriate for exploring how we conduct research assistant mentorship. This is especially useful when we are working with underrepresented scholars. Project managers and principal investigators should deliberately budget students into their research project proposals. Such inclusion will give graduates additional skills to be competitive in the arena beyond our classes and research labs.

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