BOARD # 216: Summer Internship Impacts on High School Student STEM Career Interest (Work In Progress)

Mr. Jabari Wilson, University of Florida

Jabari has experience working in project management, quality control, manufacturing, tutoring, and mentoring. He holds a bachelor's degree in mechanical engineering and has earned a master's degree in mechanical engineering with a minor in electrical engineering. Currently, Mr. Jabari Wilson is pursuing a Ph.D. in Engineering Education at the University of Florida.

Atayliya Natasha Irving, University of Florida

Atayliya N. Irving is a third-year Ph.D. student at the University of Florida (UF). She earned her bachelor's degree in computer science from Jackson State University (JSU) in the spring of 2022. At JSU, she conducted quantitative research with the Engineering Research Development Center (ERDC), where she was in the Critical Infrastructure-Cyber Protection (CICP) program. During that time, she participated in research that compared unsupervised clustering algorithms to detect attacks in the performance of algorithms for the detection of simulated cyber-attacks. Her interests have now shifted to engineering education research. The scope of her interests is to explore the experiences of marginalized students and faculty in higher learning to broaden participation in computing. Upon graduating, Atayliya aspires to pursue a career that broadens interest and representation in the STEM + C fields.

Atayliya N. Irving is currently pursuing her Ph.D. at the University of Florida (UF). She initially enrolled in the electrical and computer engineering (ECE) department at UF, but later switched to the engineering education department in her second semester. Atayliya holds a bachelor's degree in computer science from Jackson State University (JSU), which she earned in the spring of 2022. While studying at JSU, she conducted research with the Engineering Research Development Center (ERDC) in the Critical Infrastructure-Cyber Protection (CICP) program. During her time there, she worked on research projects that focused on the comparison of unsupervised clustering algorithms to detect attacks in the performance of algorithms for the detection of simulated cyber-attacks. Now, Atayliya's interests have shifted to engineering education research. She is particularly interested in exploring the experiences of marginalized students and faculty in higher learning, with the aim of increasing the participation of underrepresented groups in computing. After completing her Ph.D., Atayliya plans to pursue a career that encourages and promotes interest and representation in the STEMM fields.

Kimberly Jacoby Morris
Dr. Jeremy A. Magruder Waisome, University of Florida

Dr. Jeremy A. Magruder Waisome is an Assistant Professor in the Engineering Education Department at the University of Florida (UF). Her research focuses on self-efficacy and critical mentoring. She is passionate about broadening participation in engineering, leveraging evidence-based approaches to improve the engineering education environment.

Summer Internship Impacts on High School Student STEM Career Interest (Work In Progress)

Abstract

This Work-In-Progress paper underscores the impact of a 6-week summer internship program for high school upperclassmen in a cohort of participants. The purpose of this study is to explore how participation in the internship program affects students' STEM career interests. Lent, Brown, and Hackett's 1994 Social Cognitive Career Theory (SCCT) provides the theoretical framework for this investigation of different elements of career interest. Kolb's 1984 experiential learning theory connects SCCT to the internship experience.

The high school students in this study were assigned to the Air Force Office of Scientific Research (AFOSR) and guided through a research project on a STEM topic of their choosing by two immediate supervisors. These topics were required to be related to the host employer's work and have ample current literature available to explore. The internship also featured cohort-based activities including site visits to museums, workplaces, and learning institutions. Other features include professional development sessions, guest speakers, and a culminating event where participants presented their work and research via scientific posters to a diverse audience.

The study underway employed surveys and semi-structured interviews as the primary data sources to investigate students' experiences and how they relate to STEM career interests. In addition to the pre-survey, post-survey, and exit interviews, we also collected secondary data from weekly reflection writings from each participant. Quantitative data from each survey will be analyzed using a Wilcoxon signed rank sum test to determine differences between pre- and post-responses. Qualitative data will be coded using reflexive thematic analysis to identify themes and sub-themes of students' experiences. Currently, the analysis is in the data familiarization stage. The expected results include increased self-efficacy and an emphasis on the importance of an engaged supervisor for developing student's career interests.

1 Introduction

This case study focused on a six-week summer internship program that occurred in Washington D.C. during the summer of 2024. The program of interest for this work is called the Career Ready Internships (CRI) program and occurs as an optional work-based learning (WBL) opportunity for high school students in Washington DC who are enrolled in a Career and Technical Education (CTE) program of study (POS). The program shares similar elements with both summer bridge programs and summer youth employment programs (SYEPs). This WBL internship program has

supported CTE students in this district since 2015. In the 2024-2028 state plan, this internship program is part of the primary effort to expand work-based learning opportunities for students. The program is overseen by a supervisory team composed of one engineer and one K-12 educator. Student participants in this CTE program are matched with a host employer after an interview and selection process designed to promote alignment between the student's skills and interests and the company's needs.

Once hired, students work directly with employees to gain first-hand work experience, develop professional skills, and engage in a positive mentoring relationship. The cohort in this study consists of CTE students enrolled in their district's STEM program of study. Each participant has expressed an interest in engineering, specifically, prior to the application process. At this time, most data collected on the program has been collected as part of internal surveys and accountability measures regarding overall CTE participation in the district. A research-driven analysis, focused specifically on the CRI program has not been conducted in prior years. In their 2024-2028 state plan, the Washington D.C. Office of the State Superintendent of Education (OSSE) pointed to the CRI program as part of the primary effort to expand work-based learning opportunities for students[1]. OSSE claimed that through the CRI students can work directly with employees to gain first-hand work experience, develop professional skills, and engage in a positive mentoring relationship[2,3]. Stated goals for CRI, similar to the goals for SYEPs and summer bridge programs, included students earning income, gaining real-world work experience, developing professional skills, being mentored professionally, and building their resumes[3].

2 Purpose

The purpose of this case study is to explore the impacts of the CRI program on high school students. This work is primarily interested in the relationship between elements of the CRI program and STEM career interests of high school participants. We set out to fulfill this purpose by accomplishing two objectives:

- **Objective 1 -** To investigate how participation in the Career Ready Internship (CRI) program affects students' STEM career interests
- **Objective 2-** To investigate the impact that different elements of the Career Ready Internship program have on high school students' STEM career interests

These objectives incorporate a general exploration of the impacts of the program on students' interests and an investigation into how specific components of the program impact students' career interests. we plan to uncover answers to one research question while completing these objectives:

> **Research Question -** How do the experiences of high school students in the Career Ready Internship program affect their STEM career interests?

3 Study Methods

This case study employs multiple methods in a qualitative investigation of the relationship between the CRI program and students' interests. Creswell et al. (2013) provide the following

definition for qualitative research:

> ”Qualitative research begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem... qualitative researchers use an emerging qualitative approach to inquiry, the collection of data in a natural setting... and data analysis that is both inductive and deductive and establishes patterns or themes. The final written report or presentation includes the voices of participants, the reflexivity of the researcher, a complex description and interpretation of the problem, and its contribution to the literature or a call for change.” [4 p.44]

Creswell (2013) also points out eight common elements in qualitative research: 1) collecting data in the natural setting, 2) the researcher acts as an instrument in the data collection, 3) data is collected through multiple methods, 4) data is analyzed through inductive and deductive complex reasoning, 5) the participants' meanings are centered over the researcher's preconceptions, 6) study design is subject to change during different phases, 7) researchers are explicit about their background and other factors that affect how they interpret the data, and 8) researchers aim to depict the study in a manner that is as comprehensive as possible[4].

In this study, each of the common elements mentioned above is accurately reflected in the study design. The data is primarily collected via the computer, similar to most of the intern-employer interactions. The primary researcher for the study is also one of the intern's direct supervisors and designed some of the data collection instruments. Multiple types of data were collected and analyzed, with the qualitative and quantitative data being linked to their respective participants within each cohort. The data analysis stage of the research involves both inductive and deductive reasoning. The case study explicitly centers students' experiences in the program. Concerning reflexivity, the primary researcher will provide a positionality statement to convey how his own background impacts his interpretation of the data. Finally, this work aims to depict the internship experience and its impacts on the students as holistically as possible.

3.1 Data Collection

This case study employed multiple data collection methods. Some quantitative data was generated from a previously validated survey, the Student Interest and Choice in STEM (SIC-STEM) 2.0 Survey developed by Roller et al. in 2020[5]. The survey questions require responses on a five point Likert scale, from strongly disagree to strongly agree, with an option for neutral answers[6]. This survey was supplemented with program-specific Likert-scale questions to generate more quantitative data and with open-ended questions to generate richer qualitative data. The survey was administered once, as a pre-survey within the first 2 weeks of the program's start, and again as a post-survey after the program's end.

Qualitative data was collected mainly from semi-structured exit interviews. The interviewer followed a protocol that included an opening script, guiding questions, and potential follow-up questions. The interviews were conducted and recorded via zoom, and transcribed via a third-party transcription service. Additional qualitative data was collected from weekly reflections with complete sentence responses to three questions:

1. What did you learn at the internship this week? Please be specific about skills and/or experiences.
2. How did you learn what you learned this week? Be specific about the assignment, task, or other factor.
3. What do you like or dislike about the program so far?

These questions represent data internal to the program that we have the luxury of including in the analysis per the participation consent forms. Exit interviews were conducted within two weeks after the culmination of the program. Another source of qualitative data collected as part of each internship program was the intern entrance survey. This survey included questions about participants' motivations for choosing the internship program, choosing to work with their particular organization, and their interests in specific engineering disciplines. The entrance surveys were administered and completed within the first week of the program.

3.2 Data Analysis

Data analysis for the embedded single case study will be conducted in two distinct phases: 1) analysis of all qualitative data and 2) analysis of the SIC-STEM 2.0 pre- and post-survey responses. The multi-method analysis will follow three key methods: 1) Wilcoxon signed rank test, 2) reflexive thematic analysis, and 3) magnitude coding.

3.2.1 Quantitative Analysis

Quantitative data will be analyzed using descriptive statistics for each participant. The Wilcoxon signed rank test will be applied to the pre- and post- survey data. The additional questions and the SIC-STEM 2.0 Survey portions of the data will be analyzed separately. The SIC-STEM 2.0 Survey measures responses by discipline (science, mathematics, engineering, and technology) with respect to five constructs: 1) Choice Actions, 2) Choice Goals, 3) Interest, 4) Outcome Expectations, and 5) Self-Efficacy[5]. The resulting data were paired, dependent, and non-parametric. Due to the limited sample size of five participants, the analysis of the quantitative data will not have significant power. The quantitative data will be included as supplementary data to help characterize the qualitative data.

3.2.2 Qualitative Analysis

Qualitative data will be analyzed following the recommendations laid out by Braun and Clarke for reflexive thematic analysis (RTA) with an added initial step that roots the analysis within our theoretical frameworks[7,8,9,10,11,12,13,14]. The semi-structured interview transcripts, weekly reflections, entrance survey responses, and open-ended pre- and post- survey questions will all be redacted, with pseudonyms replacing participant names. Next, data will be grouped through deductive coding into themes that correspond to the five constructs measured by the SIC-STEM 2.0 survey: 1) Choice Actions, 2) Choice Goals, 3) Interests, 4) Outcome-Expectations, and 5) Self-Efficacy[5]. This deductive analysis will cast a wide net using latent meaning rather than semantic meaning to capture as much data as possible within each category.

After the initial deductive analysis, we will analyze the data in each theme in accordance with the six steps of reflexive thematic analysis Braun and Clarke laid out in their 2006 paper and augmented by their later works[11,10]: 1) Familiarizing yourself with the data, 2) Generating initial codes, 3) Constructing initial themes, 4) Revising themes, 5) Defining and naming themes, and 6) Producing the report.

The analysis was and will be performed primarily by a single researcher who has been immersed in each program. The researcher approached the study from a constructivist/interpretivist epistemological standpoint. Despite the possible consultation of other researchers during the coding processes, inter-coder reliability will not be a featured construct. In their reflections, the primary authors of reflexive thematic analysis characterized the idea of testing inter-coder consistency as a positivist-oriented appeal to reliability and accuracy[10]. The finalized themes will help convey the connections between the students' experiences, the constructs present in the theoretical frameworks, and research questions. It is during this final stage that the arguments for potential responses to the research question will become most explicit, with excerpts from the data being highlighted as support for the narrative. Magnitude coding will be used to further depict how the emergent themes relate to each other. The reports produced during this stage for each case study will be utilized during the comparative analysis between the cases.

4 Preliminary Findings

Our preliminary findings reflect insights from data familiarization with semi-structured interviews conducted at the conclusion of the 6-week summer internship program and survey responses. All five high school interns were interviewed about their experience in the CTE program with the AFOSR. These interviews occurred after the program concluded in August 2024, with the purpose of gaining insight and analyzing verbal responses about how interns' participation in the CRI program affected their STEM career interests.

Our preliminary findings demonstrated that students had a positive general experience in the program and felt that it improved their feelings of preparedness for college and future research. The interviewees also mentioned that the professional development sessions were particularly helpful. These sessions exposed students to different STEM career paths, which aided in them identifying potential college majors. Another commonality between the students included the value they found in the two in-person activities. These results support the projected themes of increased interest in self-efficacy, indicating the students gained confidence in their knowledge of STEM careers. Through more rigorous analysis, we expect these findings to evolve.

Table 1 includes a sample of responses to the pre- and post- survey broken down by percentage. For one of the questions included in the table, one of the five students did not respond, resulting in the percentages being split into quarters unlike the others. The pre-survey data revealed generally high expectations for the impact that the program would have on feelings of college preparation and preparation for future internships. Only one of the five respondents reported feeling neutral about expecting to feel more prepared, while all other students expected that they would feel more prepared for college and future internships. In contrast, only two respondents reported that they expected their career plans or choice of major to change due to the program. One student expected to feel more prepared to choose a college major, while all others were neutral in their

Table 1: Sample of Survey Response by Percentage

	Response	**I expect to feel more prepared for college because of the program.**	**I expect to feel more prepared to pursue other internships because of the program.**	**I expect to feel more prepared to choose an undergraduate major because of the program.**
PRE	Neither Agree nor Disagree	25.0%	20.0%	80.0%
	Agree	50.0%	20.0%	20.0%
	Strongly Agree	25.0%	60.0%	0.0%

	Response	**I feel more prepared for college because of the program.**	**I feel more prepared to pursue other internships because of the program.**	**I feel more prepared to choose an undergraduate major because of the program.**
POST	Neither Agree nor Disagree	0.0%	0.0%	20.0%
	Agree	60.0%	0.0%	40.0%
	Strongly Agree	40.0%	100.0%	40.0%

expectations about the effect the program would have on their choice of college major.

The post-survey data supports changes in feelings of preparation for college, future internships, and choosing a college major. All five participants reported feeling more prepared for college and future internships after the program. Most notably, five of the five participants strongly agreed that they felt more prepared for future internships. Only one of the students remained neutral about how prepared they feel to choose a college major, while all other students reported feeling more prepared.

5 Discussion

The interviews conducted in this study shed light on the advantages of exposing students to engineering careers and allowing them the freedom to choose a research project that aligns with their own personal interests. The preliminary survey results support a shift towards students being more prepared to choose a college major, an increased desire to attend college, and pursue increased desire to engage in future internships after completing the program. We expect the other qualitative data and quantitative data to support the argument that the program and its structure directly relate to positive increases in sociocognitive constructs for participants. In continuing the analysis of these experiences, we hope to gain a deeper understanding of how the different features of the CRI program impact participants' STEM career interests.

References

[1] V. O. Colon, "District of Columbia Career and techNical education state Plan."

[2] "Advanced Internship Program (AIP)." [Online]. Available: https://dcpscareerready.org/wbl/aip/

[3] "Career Ready Internships (CRI)." [Online]. Available: https://dcpscareerready.org/wbl/cri/

[4] J. W. Creswell, *Qualitative inquiry and research design: choosing among five approaches*, 3rd ed. Los Angeles: SAGE Publications, 2013.

[5] S. A. Roller, S. A. Lampley, M. L. Dillihunt, M. P. J. Benfield, S. E. Gholston, M. W. Turner, and A. M. Davis, "Development and Initial Validation of the Student Interest and Choice in STEM (SIC-STEM) Survey 2.0 Instrument for Assessment of the Social Cognitive Career Theory Constructs," *Journal of Science Education*

and Technology, vol. 29, no. 5, pp. 646–657, Sep. 2020. [Online]. Available: https://doi.org/10.1007/s10956-020-09843-7

[6] S. A. Roller, S. A. Lampley, M. L. Dillihunt, M. P. Benfield, and M. W. Turner, "Student attitudes toward STEM: A revised instrument of social cognitive career theory constructs (fundamental)," in *2018 ASEE Annual Conference & Exposition*, 2018.

[7] V. Braun and V. Clarke, "One size fits all? What counts as quality practice in (reflexive) thematic analysis?" *Qualitative Research in Psychology*, vol. 18, no. 3, pp. 328–352, Jul. 2021, publisher: Routledge _eprint: https://doi.org/10.1080/14780887.2020.1769238. [Online]. Available: https://doi.org/10.1080/14780887.2020.1769238

[8] ——, "Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches," *Counselling and Psychotherapy Research*, vol. 21, no. 1, pp. 37–47, 2021, _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/capr.12360. [Online]. Available: https://onlinelibrary.wiley.com/doi/abs/10.1002/capr.12360

[9] ——, "To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales," *Qualitative Research in Sport, Exercise and Health*, vol. 13, no. 2, pp. 201–216, Mar. 2021, publisher: Routledge _eprint: https://doi.org/10.1080/2159676X.2019.1704846. [Online]. Available: https://doi.org/10.1080/2159676X.2019.1704846

[10] ——, "Reflecting on reflexive thematic analysis," *Qualitative Research in Sport, Exercise and Health*, vol. 11, no. 4, pp. 589–597, Aug. 2019, publisher: Routledge _eprint: https://doi.org/10.1080/2159676X.2019.1628806. [Online]. Available: https://doi.org/10.1080/2159676X.2019.1628806

[11] ——, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, publisher: Routledge _eprint: https://www.tandfonline.com/doi/pdf/10.1191/1478088706qp063oa. [Online]. Available: https://www.tandfonline.com/doi/abs/10.1191/1478088706qp063oa

[12] V. Braun, V. Clarke, and N. Rance, "The Counselling and Psychotherapy Research Handbook." 55 City Road: SAGE Publications Ltd, 2015. [Online]. Available: https://sk.sagepub.com/books/the-counselling-and-psychotherapy-research-handbook

[13] V. Braun and V. Clarke, "(Mis)conceptualising themes, thematic analysis, and other problems with Fugard and Potts' (2015) sample-size tool for thematic analysis," *International Journal of Social Research Methodology*, vol. 19, no. 6, pp. 739–743, Nov. 2016, publisher: Routledge _eprint: https://doi.org/10.1080/13645579.2016.1195588. [Online]. Available: https://doi.org/10.1080/13645579.2016.1195588

[14] V. Braun, V. Clarke, N. Hayfield, and G. Terry, "Thematic Analysis," in *Handbook of Research Methods in Health Social Sciences*, P. Liamputtong, Ed. Singapore: Springer, 2019, pp. 843–860. [Online]. Available: https://doi.org/10.1007/978-981-10-5251-4$_1$03