Student Identity Mediators in Rural Coding Academy

Capstone Project

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Doctor of Education in Leadership and Learning in Organizations.

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Executive Summary

This project examines a nonprofit organization, Base Camp Coding Academy (BCCA), that provides a free twelve-month software developer training program to recent high school graduates nominated by faculty from their local high school or young adult mentors from their community. Located in rural northwest Mississippi, the non-profit organization is six years old and targets a population of high school graduates that do not have plans for post-secondary education.

BCCA's mission is particularly relevant at this time because the predominately rural state of Mississippi is experiencing a workforce skills deficit (National Skills Coalition, 2017). The state is experiencing a human capital flight, whereby the average education level and skills training is higher for those that leave compared to those that remain (McGraw, 2019). Graduation from a program like BCCA can help connect people (students) and possibilities (employment). Improving completion rates in the BCCA program, therefore, is important for the individual students, BCCA, and the broader community. From an economic perspective, there are tremendous job growth and salary opportunities for jobs in the technology sector. An evaluation of the number of job openings in 2016 confirmed that computing jobs are the top source of new wages in the United States (code.org) and many of these jobs do not require geographic relocation. As such, completion of software development programs like BCCA can provide in demand skills training that can help Mississippians secure job opportunities with competitive salaries.

BCCA graduated their fourth cohort in May 2020, but has recognized disproportional graduation rates for historically marginalized populations, specifically women and African Americans. The focus of this project is to understand why program participants from these groups (African Americans and females) are not completing the free year long program at a rate relative to white male peers. To better understand this phenomenon, I drew on literature that examines college completion within the United States specifically, the risk factors that can negatively impact college completion. The Loss Momentum Framework (Completion by Design) provides an approach to define the various phases across the student experience in higher education. I used the Loss Momentum Framework as a way to organize the temporal aspects of the program, each of which is associated with the potential risks for non-completion. This includes the Connection phase (when students learn about the program), the Entry phase (when students begin to attend the program), and the Progress phase (when students have completed the first assessment and continue to work to meet completion requirements (Completion by Design).

This investigation also takes into consideration the importance of role models within STEM fields. This investigation also draws on the theory of identity as a joint accomplishment whereas one's identity can change across different environments (Greeno & Grasalfi, 2008) paying close attention to student identity construction across the student experience in the Connection phase, the Entry phase, and the Progress phase (Completion by Design).

Research Questions:

The following research questions were established to guide the project.

1. *How does student identity mediate the Connection phase in the BCCA program?*
2. *How does student identity mediate the Entry phase in the BCCA program?*
3. *How does student identity mediate the Progress phase in the BCCA program?*

Key Findings

Finding 1: Student participants do not have a clear understanding of the BCCA program before starting the program, which limits their opportunity to imagine themselves as a participant of the BCCA community and as a software developer.

Student participants reported they did not understand the technical training that they would learn in the BCCA program before starting classes. This lack of understanding regarding the basic content or goals of the BCCA program limits students' opportunity to envision themselves as members of a software developer community prior to beginning the program. This can negatively impact their ability to construct their possible self as they prepare to join the community and attend classes.

Finding 2: Female student participants reported a lower academic confidence and described feeling concern about whether they belonged in the community when they started the program, a factor that can inhibit their perception that they are capable and have the skills to complete the work to become a software developer.

The majority of female student participants rated their academic ability lower than the male student participants, despite the fact that the majority of female participants self-reported the same high school GPA as the male participants (3.0 or higher). During interviews, the female student participants described feeling concern when they started the program about whether they were capable and had the skills necessary to be successful in the BCCA community. For example, during the interviews one of the female student participants recalled thinking "*I was telling myself I was the runt of the class. I was the lowest. I was the slowest member of the class".* (Female Student Participant)

This gender difference regarding the students' academic confidence suggested in the survey responses, and confirmed in the interviews, matches a broader trend in STEM fields in which female students are more likely to have a lower self-assessment regarding their ability relative to male students (Cech et. al, 2011). The impact of this variance in academic confidence and sense of belonging in a community of software developers can inhibit female students from feeling that they do belong in the community and can become a software developer in general and complete the BCCA program, in particular.

Finding 3: African American student participants reported a different experience in the professional development pillar compared to their peers regarding opportunities to learn from "others (like me) that have jobs in software development" and "others that had a similar background as me," a factor that may impact their perception of who they can become in the BCCA program and in the software development community.

While the survey data illustrates that the majority of the student participants agreed with the statement that they had the opportunity "to learn about software development from others like me," this is not the case for the African American student participants. The impact of this variance in reported opportunities to learn from others "like me" and "a similar background as me" can inhibit African American students' perceptions that they do belong in the community and can become a software developer in general and complete the BCCA program, in particular.

Finding 4: Student participants reported that other students in the program had a primary role in supporting opportunities for identity development, helping them feel that they belong in the community, with male students highlighting technical support and females highlighting both technical and emotional support from their peers.

All former students reported that they provided and relied on peer support while at BCCA. This supportive environment for students aligns with the program goals of creating a caring learning community. This feedback illustrates the important role that students had on their peers as they constructed their identity and answered the questions of if they belonged, if they could do the work of a software developer, and who they wanted to become during the program.

One noteworthy distinction is that the male students emphasized the support focused on providing each other technical instruction, while the females recalled more holistic support from their peers, which included both the technical instruction and personal relationships. This suggests that as they supported one another, the students came to see themselves as a member that belonged in the community. As such, the BCCA environment served as co-constructor of learning through peer support, which was impactful for female and male student participants.

Recommendations

Recommendation 1: Provide student marketing materials to nominators for distribution to students in surrounding school districts (high schools and middle schools) to help students develop an understanding of the program. Understanding of the purpose of the program, the goals, and the benefits can offer opportunities for students to try on an initial identity as a software developer and envision themselves as a participant in the community.

The marketing materials (i.e., public facing documents, website, social media) should focus on providing clarity on the type of training they will receive in language that prospective students will understand (i.e., build a website, create an app, etc.). This will help to establish a better understanding of the type of skills provided in the program and assist in initial identity construction as prospective students consider their future selves as a potential participant in the BCCA program and eventual software developer. In the larger recommendation below, there are examples of the how other coding camps and academies describe software development training to prospective students. The content should focus on providing inclusive images and testimonials that students can relate to inclusive of their gender, racial, or ethnic identity. Inclusive images are particularly important given the disproportionate representation of white males in the technology industry and the software development professional field. Recent STEM research indicates that including images that individuals can identify with is particularly important for African American females (but important for all underrepresented groups) because it signals that the environment is one where they can participate. (Petri et. al, 2018)

Recommendation 2: Actively recruit women and African American software developers to serve as champions for the professional development activities (i.e., professional mentors, site visits, guest speakers) in order to offer greater representation to students whose identities are currently underrepresented in the software development field.

To better support women and African American students as their identities evolve as software developers, it is important that they have access to professionals and role models that are the groups currently underrepresented in the field . The Inclusive Design Research Centre asserts that “inclusive design is design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference” (IDRC). Using this definition, it is recommended that the broader BCCA stakeholder community (i.e., guest speakers, professional mentors, and interview coaches) prioritizes representation that is inclusive of women and African Americans. This is particularly important for the BCCA community members that students interact with for extended periods of time as they will likely serve as software developer role models. This includes the BCCA professional mentors assigned to support students and the team members in which students interact with during company site visits.

Introduction

Base Camp Coding Academy (BCCA) was founded in 2015 in rural Mississippi. The organization started as a three year pilot program to provide free software development training to students that did not have plans to attend college following their high school graduation. The comprehensive program sought to provide workforce development training to young adults in Northwest Mississippi to support their entry into the workforce while also helping local technology companies in need of qualified applicants. Through individual funding by local citizens and several corporate sponsors, the six existing Board of Trustees established curriculum and resources to teach up to forty students per year. In addition, they established a partnership with a local community college (Northwest Mississippi Community College). The community college provides funding for one of the program instructors and endorses the program by awarding BCCA graduates with 45 hours of college credit.

In addition to their partnership with this local community college, the organization relies on strategic partnerships with local organizations and employers to provide financial support instead of charging tuition and fees to students. In addition to not charging tuition, they provide numerous methods of financial support to students that are enrolled in the program which includes: lunch, gas cards to assist with commuting costs, and interview clothes, to name a few. Since its inception in 2015, the organization completed a three-year pilot and in May 2020 graduated their fourth cohort. In just five years, the program has demonstrated success in providing software development training and helping graduates secure employment.

BCCA students are from communities in northern part of the state, and the majority of students live in the surrounding eight counties in northwest Mississippi. BCCA relies on high school faculty, coaches, or other young adult mentors in these surrounding counties to identify and nominate students for the program. The nomination process requires the submission of student nominations. This is then followed by an introduction interview with the nominated student, an aptitude test, and in-depth interviews with BCCA staff members and board members.

The BCCA program is designed according to three pillars, which include technical training, professional development, and community (see Figure1). The technical training focuses on developing knowledge of the most common coding languages (i.e., Python, Java, CSS) and applying them to projects where they build their own portfolio. The BCCA curriculum is recognized by Northwest Community College as an appropriate substitute (up to 45 hours) for technical courses towards a Computer Programming Associates degree. The professional development pillar provides students the knowledge and assistance to build a resume, practice interview skills, and conduct presentations to refine their public speaking abilities. As part of this pillar, students visit technology companies, shadow professionals in the software development profession, and work with professional mentors assigned through BCCA. Finally, the community pillar emphasizes the importance of teamwork and student contribution(s). They each have to

sign up for weekly chores to help maintain the community workspace. In addition, they serve on a project team to give back to the program.

Figure 1: BCCA Program Pillars

The overall Mississippi student population (K-12) is comprised of 47% African American, 43% White, 4.3% Hispanic, and 1% Asian (Figure 2). As of 2020, BCCA had a total of forty-one students graduate from the program. When the BCCA graduation rates are compared to the Mississippi Student demographic information, an imbalance in gender, race, and ethnicity is illuminated. For example, females represent 49% of the state population compared to 24% of BCCA graduates. A similar picture is illustrated for African American students which represent 47% of students in Mississippi compared to 29% of BCCA graduates.

Figure 2: Mississippi Student Demographic Information (2020) vs. BCCA Grads

Mississippi Students*		**BCCA Graduates ****	
Group	**Percent (%)**	**Percent (%)**	**Count**
Female	48.98%	24%	10
Male	51.02%	76%	31
Asian	1.15%	0%	0
African American	47.72%	29%	12
Hispanic or Latino	4.39%	22%	9
American Indian or Alaskan Native	0.22%	0%	0
White	43.13%	46%	19
Two or More Races	3.33%	2%	1
Native Hawaiian or Pacific Islander	0.06%	0%	0

Sources: *MS Department of Education, ** BaseCamp

The counties surrounding BCCA which provide most of the student nominations have varying student demographics. Some school districts have a majority of white students, some school districts have a majority of African American students, while some school districts have a more balanced student population (Figure 3). The BCCA nominations by county illustrate that five counties represent 65% of the student nominations including: Lafayette, Lee, Pontotoc, Tallahatchie, and Yalobusha. Four of these five counties have a majority (50% or above) of white students with the exception of Tallahatchie which has a majority of African American students.

Figure 3: County & School District Demographic Information (2020) vs. Student Nominations

County	District	White	Black	Hispanic	Asian	% of Total Student Nominations
Grenada	Grenada	47.0%	49.0%	0.5%	0.4%	3.0%
Lafeyette*	Lafeyette County	72.0%	22.0%	2.7%	0.5%	16.0%
	Oxford City	52.0%	32.0%	6.5%	4.0%	
Lee*	Lee County	65.0%	28.0%	2.8%	0.0%	8.0%
	Tupelo City	33.0%	52.0%	6.7%	2.4%	
Panola	North Panola	3.7%	95.0%	0.0%	0.0%	4.0%
	South Panola	39.0%	55.0%	2.2%	0.0%	
Pontotoc*	Pontotoc County	76.0%	9.9%	11.6%	0.6%	7.0%
	Pontotoc City	51.0%	27.5%	16.0%	0.0%	
Tallahatchie*	East Tallahatchie	11.0%	85.0%	0.0%	0.0%	12.0%
	West Tallahatchie	0.0%	99.0%	0.0%	0.0%	
Union	New Albany	52.0%	26.0%	14.0%	2.3%	3.0%
	Union County	87.0%	7.5%	2.6%	0.0%	
	Union Public	72.0%	23.0%	0.0%	0.0%	
Yalobusha*	Water Valley	52.0%	42.5%	0.0%	0.0%	22.0%
	Coffeville	16.0%	82.0%	0.0%	0.0%	

Source: MS Department of Education, https://newreports.mdek12.org/
*Represents top 5 county for the number of student nominations.
Note: BCCA is physically located in Yalobushu county

The BCCA graduate population can be further understood by viewing the intersections of gender, race, and ethnicity. As illustrated in Figure 4, ten of the forty-one graduates are females (24%), yet only three of the forty-one graduates are African American females (7%), and two of the forty-one graduates are Hispanic females (5%). While thirty-one of the forty-one graduates are male, only nine are African American (22%), followed by seven Hispanic males (17%).

Figure 4: BCCA Graduate Data

BCCA Graduates (Gender, Race, Ethnicity)

Female	**10**	**24%**
African American	3	7%
Hispanic	2	5%
White	5	12%
Male	**31**	**76%**
African American	9	22%
Hispanic	7	17%
Other	1	2%
White	14	34%
Grand Total	**41**	

Additional research (specific to the technology industry) confirms that the low representation of women in technology firms is a broader issue in the United States. Using data collected by the United States Bureau of Labor, the National Center for Women & Information Technology reported that women held approximately 25% of the computing related positions. Of the 25% of women in computing related positions, 16% were white women, 5% were Asian women, 3% were African American women, and 1% of Latina women (Ashcraft, McClain, & Egar, 2016, pg. 6).

As BCCA supports their fifth cohort and prepares for their sixth group of students, they are seeking to understand what changes they can make to improve the retention of African American students and women through completion of the program. Given this problem, the purpose of this investigation is to explore the factors that may mediate identity construction as students learn about and participate in the free twelve-month technology training program with the intent to provide recommendations on how the organization can improve retention for African American and female students.

Literature Review

In what follows, I outline relevant literature on college completion, situated learning, and inclusion in Science Technology Engineering & Mathematics (STEM). Although BCCA is not technically a college, I draw on this research because Colleges have increasingly become more inclusive of post-high school certificate programs and offer relevant findings related to the focus of this investigation. Research on higher education can also inform key risk factors associated with successful college completion which can include student socio-economic factors, levels of student engagement, and perceived academic ability. When it comes to STEM fields, and especially the technology industry, it is well documented that there is a disproportionate representation of males, particularly white males that work within the technology industry. Relatedly, I considered research on inclusion efforts in STEM related fields that highlight the importance of inclusive role models and social identity considerations. The final portion of this review of literature conceptualizes identity in an effort to attend to issues of underrepresentation and inclusive support. I draw on Hand and Gresalfi (2015) to conceptualize identity as a joint accomplishment and build on socio-historical understandings of identity development, rather than overly individualistic models of identity.

College Completion

The U.S. Department of Education completed research of two year and four-year college institutions to understand the reasons student depart early from college. Through this research, seven unique characteristics were identified that increase a student's risk of not being successful in college (Bradburn, 2002). These include 1.) delayed enrollment, 2.) completion of a GED or not completing high school, 3.) financial independence from parents, 4.) being a single parent, 5.) having dependents other than a spouse, 6.) attending college part time, and 7.) working full time (Bradburn, 2002). Further, research found that of the college students with two or more of the seven characteristics, only 25% earned a degree or certificate (Greene et. al, 2008). In addition, previous research indicates that historically marginalized groups enrolled in college may be impacted by the domino theory. This theory notes that disadvantages collide with other disadvantages which then serve as obstacles to program completion (Gerardi, 1996).

Under the topic of college completion, researchers suggest that there is a relationship between student engagement and graduation rates (including short term certificates), with student engagement generally defined by the time, effort, and energy students exert to educational activities and institutional conditions that encourage participation (Greene et. al, 2008). Additional research suggests that engagement may be a contributor in completion rates

highlighting specific activities including active and collaborative learning, student and faculty interaction, and support for learners (Price & Tovar, 2014).

Published in 2013, and funded by the Bill & Melinda Foundation, the Loss / Momentum framework (Completion By Design) was established to define the phases across the student experience in higher education. In particular, the boundaries outlined in the framework are intended to provide parameters whereby colleges can analyze and identify the areas (when and where) they are losing students. These phases also support colleges to identify strategies (by phase) to gain momentum as they strive to improve outcomes. The framework includes four distinct phases: Connection, Entry, Progress, and Completion. The Connection phase is defined as the time "from interest in college enrollment to application" which is then followed by the Entry phase which is the time "from enrollment to completion of first college-level course" (Completion by Design). The Progress phase includes the "enrollment into program of study to 75% of requirement completion" (Completion by Design). The final phase is Completion, which is when students "complete program of study to credential with labor market value" (Completion by Design).

STEM Representation

STEM fields, particularly in the technology sector has had a historical overrepresentation of white men. Using data collected by the United States Bureau of Labor, the National Center for Women & Information Technology reported in 2019 that 76% of workers in the technology industry were male. Within the male population of technology workers, white males accounted for the largest percent of these workers, followed by African American males, and Hispanic males. As part of this same analysis, an estimated 25% of the technology sector was comprised of females. This included 16% white females, 5% Asian females, and 3% African American females. (National Center for Women & Information Technology, Women in Computing Jobs 2019)

Role Models & STEM

A significant amount of research now exists regarding inclusion challenges in STEM education and careers within the United States. The importance of role models and positive effects of having demographically similar teachers was highlighted by Egalite & Kisida (2018) through their research that explored student academic perceptions and attitudes tied to their classroom teachers. This research found that matching students to teachers with similar gender and/or race resulted in students rating their teachers higher in the following areas: feeling cared

for, feeling their schoolwork was interesting, and student to teacher communication (pg. 74). The results also align with the theory of cultural understanding "which suggests that teachers of color may be particularly well situated to explain new material in a culturally relevant and engaging way" (Egalite & Kisida, 2018, pg. 75).

In a 2010 study at the United States Airforce Academy, Carrell, Page, & West (2010) investigated role model effects of having STEM professors that were similar to students' gender identity. The research found that in higher education professor gender had a noticeable impact on the performance in math and science courses for female students. In particular, they found that having a female professor was most significant for female students that had the highest SAT math scores. For these high ability female students, a female professor appears to eliminate the gender gap for introductory math and science courses. Through this research, they also determined that this student and professor pairing may result in a greater percentage of high ability female students to pursue a STEM major (Carrell, Page, & West, 2010).

Additional research on the importance that role models have regarding whether or not females pursue STEM careers looked at influences outside the classroom. For example, Risse, Willage, and Willen (2019) conducted a Norwegian study that found having a female primary physician during childhood may have a positive impact on STEM performance for female students. This is another example that illustrates the importance of having role models that students can identify with, particularly for women in STEM fields.

Situated Learning and Participation

Situated learning theory emphasizes that individuals never act as autonomous agents and that success in any activity cannot be separated from individuals' co-constructed identities and joint accomplishments when it comes to participation (Greeno, 1998).Lave and Wenger (1991) provided initial theoretical framework for understanding human action as always socially and historically situated, a framework that emphasizes a broad unit of analysis with an emphasis on legitimate peripheral participation (LPP) in communities of practice. LPP recognizes that learning is represented in the change of participation as members engage with the community and tools differently. LPP has been used to highlight the importance of affordances to facilitate participation and engagement (Greeno & Grasalfi, 2008; Leve & Wenger, 1991). Central to the frame of LPP is the argument that participation in a community of practice is as much a process of identity transformation as it is acquiring information. Finally, capturing feedback on student self-perception and academic achievement of underrepresented groups in the college environment provides insight into their perceptions that influence the construction of student identities (Vallejo, 1983; Larnell, 2016).

Student Identity

Building on these conceptions of learning as a situated and identity-oriented activity, Hand and Gresalfi (2015) define identity as "one's participation in and across activities and the sense one makes of oneself in relation to these activities" (pg.191). They assert that identity is a *joint accomplishment* that takes into consideration how one interacts with "norms, practices, cultural tools, relationships, and institutional and cultural contexts" (pg. 190). One's identity, or who they are, changes as a person transitions across different social contexts that have different norms, expectations, or valued practices (pg. 191). In other words, individuals can act and see themselves very differently depending on the environment and community they are engaged with at any given time. Along these lines, access to a new environment and activities can impact an individual's perspective on who they are and their perception of who they can be in that new and different context.

Larnell (2016) builds on this situative understanding of identity and explains that institution-level forces which can include policies, instructors, support programs, and placement tests all become resources by which student identities are constructed and negotiated. His study of African American college mathematics students demonstrates that "there are community forces that interact with institutional forces—for instance, families, fictive kinships, home-community conditions (and expectations among these groups)" in the complex construction of identity (Larnell, 2016, pg. 241). As such, consideration of both institutional level forces and sociohistorical forces are essential because each can influence students as they continuously evolve their identities (Larnell, 2016).

Conceptual Framework

This research study leveraged the conceptualization of identity presented by Hand and Gresalfi (2015), specifically the lens that identity is a joint accomplishment that changes over time depending on one's interactions with situated activities, communities, and contexts. This study overlaid this conceptualization of identity (the what) with the first three phases of the © Completion by Design Framework for student experience in higher education to frame (the when) the research questions below (Figure 5).

Figure 5: Conceptual Framework

Research Questions

1.How does student identity mediate the connection phase in the BCCA program?

The first research question was focused on understanding how student identity mediates the connection phase. The connection phase is when students first learn about BCCA and explore their "possible self" as a potential member of that community.

2.How does student identity mediate the entry phase in the BCCA program?

The second research question was focused on understanding how student identity mediates the entry phase. The entry phase is the time when students start the BCCA program and participate as members of the community. During this time, students begin to ask themselves "if they belong" and "if they can be" a software developer.

3.How does student identity mediate the progress phase in the BCCA program ?

The third question focused on how student identity mediates the progress phase. This is the timeframe between completing the first quarter of the program to the end of the third quarter of the program. During this time, students have demonstrated progress within the program and have been exposed to the larger BCCA community where they have accessed professional mentors, completed site visits to technology companies, heard various guest speakers, and learned numerous coding languages (i.e., Python, JAVA). Throughout this phase, students explore and "try on" identities to determine "who they can become" and "who they want to become".

Each of these three research questions offer valuable insight regarding the relationship between identity through the student experience with BCCA.

Project Design

Data Collection & Methods

In an effort to gain a rich understanding of student experience as outlined in the research questions above, surveys and interviews were used as primary methods of data collection. Babbie (2015) notes that qualitative research methods allow for strong depth of understanding with the primary purpose of discovering underlying meanings and patterns of relationships.

Various stakeholders were targeted for interviews and surveys with a particular focus on nominators and former student participants in the BCCA program. Interviews with the two instructors that provided the technical instruction and professional development were also completed along with an analysis of existing BCCA data and documentation review. During the timeframe of this study, the world was faced with the COVID-19 pandemic. As such, in person interviews were not feasible and these were shifted to online interviews.

Stakeholder Group: BCCA Faculty (Interviews)

Data collection started during the middle of 2020. The first data collection included individual interviews with BCCA staff members. The interview samples included all current BCCA staff members specifically two instructors and one acting Executive Director. These semi structured interviews were designed to gain a common understanding of perceptions and challenges for students from those working within the organization (Appendix A). For example, participants were asked for their feedback on common challenges students faced while enrolled at BCCA. These interviews were conducted and recorded online (via Zoom) with transcripts captured for analysis.

Stakeholder Group: Nominators (Interviews & Survey)

To better understand the Connection phase, which includes the point of interest into the program through enrollment, interviews with nominators were conducted and recorded online via Zoom. Purposeful sampling was used, specifically the individuals with the highest number of student nominations from their county where a valid email address was available. Four of the ten 'top nominators' participated in semi structured interviews resulting in a 40% response rate. The participants included three teachers and one vice principal from various counties including: Lafayette County, Lee County, Grenada County, and Tallahatchie County. The interview guide relied on open ended questions to gain insight into their knowledge of the BCCA program, the process they used to identify students for BCCA nomination, and the message they provided to students about the BCCA program (Appendix B).

Using the qualitative data collected through the four nominator interviews, thematic coding was used to identify trends. I drew on Babbie's (2015) approach to thematic coding in an effort to categorize individual pieces of data in light of Hand and Gresalfi's (2015) elements of

identity outlined above. Using the elements of identity and the Loss Momentum Framework phases described in the framework, the themes collected from the interview data were incorporated into a survey that was created in Qualtrics. Convenience sampling was used as the survey was distributed to all individuals that nominated at least one student through May 2019, had a valid email address, and were not members of the BCCA staff. The survey yielded twelve responses, a 13% participation rate for nominators. The nominator survey included ten questions that were focused on understanding topics also discussed during the nominator interviews which included how nominators select nominees, what and when they communicate to nominees, nominators experiences interacting with the BCCA nomination process, and to capture feedback on what would assist them in their future communication to students and potential nominees (Appendix C).

Stakeholder Group: Former BCCA Students (Survey & Interviews)

To gain insight into BCCA student experiences, a survey was created in Qualtrics and distributed via email to former students. Convenience sampling was used so that all former students that attended BCCA between May 2016 and May 2020 with a valid email address had the option to participate. A total of fifteen out of the seventy-three former students participated in the survey representing a 20% response rate. The participants included students from each of the four previous cohorts and included demographic representation across gender, race, and ethnicity as intended. Survey participation was primarily from students that completed the program. Not having balanced representation from students that did not complete the program is a limitation (See figure 6 below).

Figure 6: Student Survey Participants (Self-Identified cohort, gender, ethnicity)

Former Student Survey Participants

	African American	Hispanic	Other	White	*Percentage*
Female	1	1	1	3	40%
Class of 2017 (year 1)				2	
Class of 2018 (year 2)					
Class of 2019 (year 3)	1			1	
Class of 2020 (year 4)		1	1		
Male	4	1		4	60%
Class of 2017 (year 1)	1			1	
Class of 2018 (year 2)	2			1	
Class of 2019 (year 3)		1		1	
Class of 2020 (year 4)	1			1	
Total	5	2	1	7	15
Percentage	*33%*	*13%*	*7%*	*47%*	

The survey design included questions to understand student participation in the community of practice, student engagement, factors that may have influenced their identity construction, and college completion risks factors. Survey questions included open ended questions and scale-based questions (See Appendix E, Student Survey). The first section of the survey included questions where participants self-identified their cohort, graduation status, and demographic information (Student Survey Questions 1 – 6). This was followed by socio-economic questions that were based on the US department of Education colleges success factors which included: father's education level, mother's education level, sibling education level, family income, marital status, and employment status during enrollment (Student Survey Questions 7 – 16). There were also survey questions to understand their experiences in the connection phase specifically how and what they learned about the program (Student Survey Questions 17 – 19). This was followed by survey questions to understand their self-concept of ability. These five questions (Student Survey Questions 20 – 25) were sourced from the Brookover Self Concept Ability Scale (Brookover, Thomas, & Paterson, 1964). In addition, a portion of the questions designed to understand student engagement and perceived affordances were selected and adapted for software development from the Student Reactions to College Questionnaire (Gerardi, 1996).

Student interviews were also an important form of data collection as former students were the primary stakeholder group for this research project. Semi structured individual interviews with students from each cohort were conducted and recorded via Zoom to gain a rich understanding of their experiences with BCCA (See Appendix D). The interview guide relied on open ended questions to gain insight into their experiences while they attended BCCA with a focus on understanding the factors that may have influenced their identity construction across the Entry, Connection, and Progress phases. For example, the first question requested that they describe how they learned about the BCCA program. This was followed by questions on why they enrolled, how their peer students helped them progress in the program, and describing a memorable experience, to name a few.

Convenience sampling was used so that all former students that attended BCCA between May 2016 and May 2020 with a valid email address had the option to participate in the interviews. Seven of the seventy-three former students participated in the survey representing a 10% response rate. The participants included students from each of the four previous cohorts with five males and two females which included representation from various races and ethnicities as intended. Interview participation was only from students that completed the program. Not having representation from students that did not complete the program is a limitation.

Other Data (BCCA Organization & Stakeholder Community)

Finally, this study included analysis of an extensive body of documentation. For example, there was a review of the BCCA website which included the student nomination form. In addition, an individual review of all historical newsletters through May 2020 was completed. This documentation review also included an evaluation of the historical media publications associated with BCCA. Finally, there was also an assessment of the racial and gender composition of the board and the 2020 professional mentors.

Analysis

Due to the small sample size, inferential statistical analysis was not completed for the data collected. Instead, all interviews were transcribed and coded. Themes within the data set were documented and reviewed holistically to identify emergent patterns. Additionally, survey data was assessed in Qualtrics with a focus on understanding the feedback across the various phases of the student experience and if there were differences based on gender, race, or ethnicity.

All interviews were transcribed and coded using the conceptual framework concepts outlined in the literature review. Themes were captured with special attention to areas that may influence the construction and evolution of student identities. For the nominator interviews, there was a focus on the understanding the process used by nominators which included how they described the program to students and what they looked for in students (attributes) that they nominated. The student interviews were closely assessed to look for patterns where they discussed their understanding of the program, their self-perception during the program, and support structures.

All survey data was collected and analyzed in Qualtrics. The nominator survey was reviewed to understand themes regarding what was communicated to students that they nominated. Another question focused on understanding the process they used to nominate students, specifically if they collected feedback from other faculty members when they placed a student nomination. Another important step in the analysis was the comprehensive review of the data collected in the student survey. First, there was review of the participant data to confirm the representation across student cohorts, gender, race, and ethnicity. Next, the survey data regarding socio-economic status was reviewed to identify any particular emerging themes. Then, the responses to the survey questions surrounding college success risk factors were analyzed to determine if any particular risk factors were represented in the data. The open-ended question regarding what students knew about the program before they attended classes was analyzed and coded into categories.

The next step was to review the responses to questions regarding the students' self-concept of ability (school ability). Due to the different responses, a cross tab analysis was

completed to view responses by gender, race, and ethnicity to identify patterns. Finally, the survey questions regarding the students' participation and perceived affordances were also assessed via a cross tab analysis to gain an understanding of responses by gender, race, and ethnicity to identify any potential themes.

As described above, analysis was completed within each data set. This was then followed by a holistic review across data sections to identify and confirm themes. For example, the student survey data responses regarding their self-concept of ability (by gender and race) were then compared to the themes captured in the student interviews looking for both connections and differences.

Key Findings

Finding 1: Student participants do not have a clear understanding of the BCCA program before starting the program, which limits their opportunity to imagine themselves as a participant of the BCCA community and as a software developer.

I considered the ways that student participants described their experiences and construction of possible self during the Connection phase, which is the time in which they first learn about the program until they begin to attend class. Hand and Grasalfi (2015) assert that having "salient roles for learners enabled learners to author themselves" towards a particular field and assists with the production of an individual's learning identity (Hand & Grasalfi, 2015, pg. 195).

To understand the connection phase, the survey included an open-ended question to capture *what [students] knew about the BCCA program* before starting the program (Student Survey, Question 18). This question sought to gain insight into what students did or did not understand about the program and what information they did (or did not) use to develop their identities as a participant in the community before they started classes during the Connection Phase. Almost half of the student participants indicated that they did not understand the program before they attended classes. Six of the fifteen student participants (40%) responded with comments that fell into the categories that they knew "nothing" or "online information". Eight of the fifteen student participants (53%) responded they knew it was to teach "software development" or "coding". One of the fifteen student participants (7%) responded that they didn't fully understand the program other than it had to do with computers / software.

During interviews I explored this apparent lack of understanding by asking the student participants about their understanding of the program before starting classes (Student Interview Guide, Appendix C). All of the seven student participants confirmed their

understanding that it was a free program and involved computers. However, similar to the student participant survey results, five of the seven students indicated that they did not have an understanding of what the program entailed or the type of work that is associated with being a software developer. Samples from the interview transcripts that illustrate the different understanding expressed by the student participants are included below.

> And I didn't know it had anything to do with like writing code or software. Like I, when I, when she told me about it, I thought it was just like, you know, working on like hardware and like actual computer pieces. (Former Student Interview, White Male)

> I didn't know what to expect. I'll be honest with you before, before base camp. I have never heard of, um, the career if, you know, software developer or, you know, um, uh, you know, software engineer. Um, yeah, I honestly didn't have any idea of, you know, uh, I knew about coding, I've seen it, you know, like in movies or, you know, sometimes videos I would pop up in social media, but I didn't actually know the name of the career and you know, how all that started. (Former student interview, African American Male)

The student participants (five of the seven interviews) who experienced this lack of understanding regarding the BCCA program like those cited above, were limited in their opportunity to envision themselves as a participant in the community until they started the program. In participatory identity terms, the lack of understanding of the program stymied their ability to construct their possible self as software developer before classes started. Similarly, the participant(s) that misunderstood the program may have envisioned themselves differently based on their unclear understanding of the practices and activities that organized program participation. The students that understood the program had the opportunity to envision their future self as someone that could learn to code in advance of starting the program.

Another consideration regarding the Connection phase and construction of possible self is related to *when students learn about the BCCA program*. This is relevant to the research as there is a continued effort within the United States Education system to expose students to STEM as early as possible to foster student interest in these fields, which is demonstrated through the numerous education programs for K-12 students and the significant financial investment by the U.S. Department of Education in 2020 to support these programs (https://www.ed.gov/stem). To gain an understanding on when students first learn about the program, I collected data via student interviews and the nominator survey. Student participants that were interviewed were asked how they first learned about the program. Six of the seven student participants indicated that they learned about the program during their senior year of high school. One of the seven student participants stated that they first learned about the program

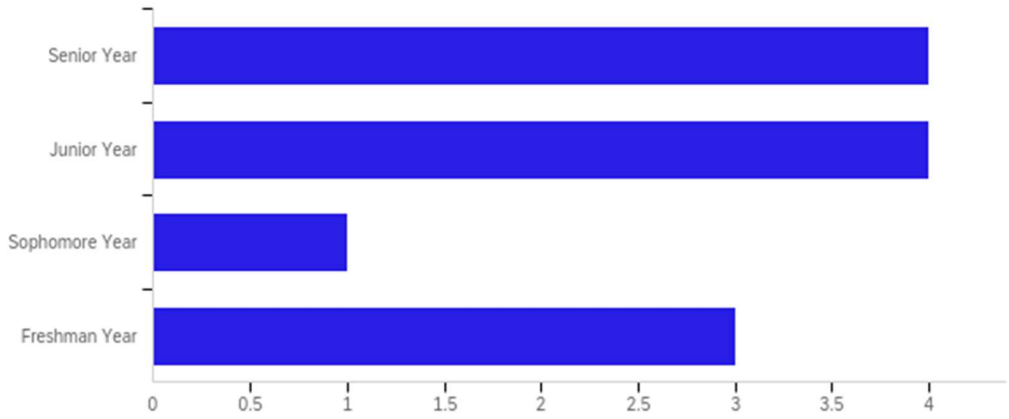
during their freshman or sophomore year of high school during a presentation from one of the co-founders of BCCA. Portions of the student participant interview transcripts are provided below.

> So, they would come to my school a lot to like advertise themselves and try to get kids to enroll. So, that's how I found out about it in 9th or 10th grade when Kagan uh, talked about it at some big events around town that I went to. … And, uh, after doing a lot of research on it through school projects, it just sounded like something that was perfect for me. (White Male)

> It was my second semester in high school think I was in English. She brought it up in class and I stayed after and talked to her about it. And you know, I was kind of in between, um, cause you know, there wasn't much information. It was just like computers. That's like, that's like the only thing that stood out. Um, and obviously it being free. I talked to my parents about it. (White male)

The student participant that learned about the program during their freshman or sophomore year of high school had more time to acquire knowledge and understand the program, discuss the program with others, and construct their possible self as a participant in the community compared to the shorter timeframe experienced by the other student participants that learned about the program during their senior year. Finally, a question was included in the nominator survey (Nominator Survey, Question 6) to understand when nominators discussed the BCCA program with the students that they nominated. Four of the twelve nominator survey participants (33%) stated they discussed the program with students in their senior year. Another four of the nominator survey participants (33%) indicated they discussed this program with students during their junior year of high school. Three of the twelve nominator survey participants (44%) indicated that they discussed the program during a student's freshman year of high school. One of the twelve nominator survey participants (8%) indicated that they discussed the program with students during their sophomore year of high school. This suggests that the majority of nominator survey participants (eight of the twelve, 66%) discussed the program with students during their junior or senior year (Figure 7).

Figure 7: Nominator Survey Results, Question 6



Answer	%	Count
Senior Year	33.33%	4
Junior Year	33.33%	4
Sophomore Year	8.33%	1
Freshman Year	25.00%	3
Total	**100%**	**12**

Finding 2: Female student participants reported a lower academic confidence and described feeling concern about whether they belonged in the community when they started the program, a factor that can inhibit their perception that they are capable and have the skills to complete the work to become a software developer.

During the entry phase, students started to attend class, gained a better understanding of the program, established initial relationships with their peers, and learned at least one software coding language. All of these experiences influenced their continued identity construction as they explored their membership of the BCCA community and answered the questions "do I belong?", and "can I become a software developer?".

As part of the student survey, participants were asked to select the range that best described their high school GPA out of the following options: 2.5 or below, 2.5 to 3.0, 3.0 to 3.5, or 3.5 to 4.0 (Student Survey, Question 19). There were two additional questions that asked students to rate their school (academic) ability by selecting one of five statements: I am the best,

I am above average, I am average, I am below average, or I am the poorest compared to their close friends and their BCCA classmates (Student Survey, Questions 20-21).

The survey results varied by gender. The responses indicated that five of the six female student participants (83%) rated their school ability compared to their close friends as average. This was surprising as the majority of the female student participants, specifically five of the six (83%) self-reported a high school GPA of 3.0 or above. Six of the eight male student participants (66%) self-reported a GPA of 3.0 or higher. Yet, when asked to rate their school ability compared to their close friends, seven of the eight male student participants (78%) selected “I am above average”.

Another example of the varied results by gender was demonstrated when asked to rate their school ability compared to their BCCA classmates. In response to this question, seven of the eight male student participants (78%) selected “I am above average” compared to four of the six female student participants (66%) which selected “I am average” (Appendix F). Although these survey findings are not definitive for demonstrating significant gender differences among student participants, the findings certainly suggested a potential pattern for exploration in the student interviews.

As part of the student interviews, participants were asked to recall how they saw themselves at the beginning of the BCCA program. The data collected from the interviews provides a similar picture of the data collected in the survey. The two female student participants recalled feeling a sense of self-doubt and lower academic confidence. This did not align with the accounts of the male student participants, who recalled feeling anxious about the new experience but did not make comments regarding their academic confidence or sense of belonging.

> And people were thinking like, Oh, she's smart. I was like, I'm not really smart. It's just, I kinda just went to school a little bit and learned it. (Female)

> I was telling myself I was the runt of the class. I was the lowest, I was the slowest member of the class. (Female)

> I saw myself as an unprepared kid and I was going to try to, you know, just make it work, try to land on my feet when I, whatever, whatever happens. (Male)

> I was still kind of eager, you know, to, you know, work my way up. (Male)

This gender difference regarding the student participants academic confidence and sense of belonging is noteworthy because it is aligned with broader trends in STEM fields in where female participants are more likely to have a lower self-assessment regarding their ability relative to male students (Cech et. al, 2011). This is also reflective of the research in regarding the number of women in STEM fields (National Science Foundation, National Center for Science and Engineering Statistics, 2019).

This suggests that during the Entry phase, the time in which students start to attend classes, begin to construct their identity to determine *if they belong in the community*, and consider if they *can be a software developer*, the female students tend to perceive themselves as average while the male students tend to perceive themselves as above average. The impact is that the lower academic confidence can inhibit the perception of female students that they are capable, belong in the community, and are capable to complete the work of a software developer.

Finding 3: African American student participants report a different experience in the professional development pillar compared to their peers regarding opportunities to learn from "others (like me) that have jobs in software development" and "others that had a similar background as me", a factor that may impact their perception of who they can become in the BCCA program and in the software development community.

In what I conceptualize as the Progress phase, students have completed the first three months of the program, learned multiple coding languages, and gained exposure to extended members of the BCCA community through the professional development pillar. The professional development pillar experiences include interview preparation, professional etiquette training, professional mentors, and visits to various tech companies where they can shadow different team members. All of these opportunities served as professional development experiences during the Progress phase and influenced the student's identity construction as they explored and tried on identities to formulate *who they could become and who they wanted to become* in the spaces of software development. The former student survey included questions about student experiences during BCCA specifically related to the professional development pillar (Student Survey, Question 28). Student participants were instructed to select the statements that they agreed with based on their experience as a student at BCCA.

During analysis, I recognized differences in this group of student participants and completed analysis to understand the responses by gender, race, and ethnicity. As part of the survey, student participants were asked whether they agreed with several statements regarding their student experience (Student Survey, Question 28). For the statement "I learned from others (like me) that have jobs in software development", twelve of the fifteen student participants

(80%) agreed with the statement. However, the three student participants that did not agree with the statement were all African American students. In fact, only two of the five African American student participants (40%) agreed with that statement. Students were also asked whether they agreed with the statement "I had opportunities to learn from others that had a similar background as me". While overall, ten of the fifteen student participants (67%) agreed with the statement, only two of the five African American student participants (40%) agreed with that statement.

To understand the students' perspective regarding their career planning during the Progress phase, students were asked whether they agreed with the statement "I talked to someone at BCCA about my future plans". Ten of the fifteen student participants (67%) agreed with this statement which aligns with the program goals for career planning. Once again, there was a difference for the African American student participants as only two of the five (40%) agreed with that statement. To understand the students' experience in identifying a job of interest, student participants were asked whether they agreed with the statement "I identified what type of job I would like". Eight of the fifteen student participants (53%) agreed with this statement. This was not the case for the African American student participants as only one of the five (20%) agreed with that statement (Appendix G). Although these survey findings are not definitive for demonstrating significant differences among African American student participants, the findings certainly suggested a potential pattern for exploration especially since research on STEM fields and software coding in particular illustrates that historically marginalized populations including African Americans are not well represented in the STEM workforce (National Science Foundation National Center for Science and Engineering Statistics, 2019).

This pattern emerged during the student interviews where one African American female participant recalled the site visits that she completed while enrolled in BCCA. During the interview she described one site visit where she encountered a majority of male workers. As part of her statements about this site visit, she communicated her perception that females did not belong in that environment, and the perception that she did not see herself joining that organization as software developer. Although the student participant refers to gender differences rather than race in this quote, the sense that 'they are going to look for people that are just like them' provides insight regarding how she perceived herself in that space. A portion of this student participant interview transcript is provided below.

> And then one place that we went to, it was a bank and all you see was like, mostly guys, mostly. So I'm like, okay, I'm not going to work here because I know them probably not going to hire a lot of females. They're going to look for people that are just like them. (African American female)

In addition to the student survey results, an analysis of the professional mentor program was completed to gain an understanding of the community members, specifically the demographics of the mentors that students were engaged with during the fourth cohort (class of 2020). The 2020 BCCA professional mentors included thirteen professionals across several technology firms. The results of the analysis found that eleven of the thirteen professional mentors (85%) where white. Seven of the thirteen mentors (54%) were white males, and four of the thirteen mentors (31%) were white females. Two of the thirteen (15%) mentors were people of color with one African American female (7.5%) and one Asian male (7.5%). This is not surprising given the existing research that illustrates the technology workforce in the United States does not have inclusive representation for historically minoritized populations, including African Americans (National Science Foundation, National Center for Science and Engineering Statistics, 2019).

While the survey data illustrates that the majority of the student participants report having the opportunity to learn from others like them, this is not the case for the African American students. In particular, they expressed having less opportunity to learn from other software developers like them. This is an important distinction regarding the environment that these students experienced during the Progress phase. During this phase of the student experience, students continued to complete identity work to determine who they wanted to become. If the African American student participants did not have the opportunity to learn from others that they could relate to (and identify with), this likely hindered their ability to successfully determine who they wanted to become and does not align with the intent of the professional development pillar.

Finally, the survey data illustrates that the majority of student participants (67%) reported that they discussed their future plans with someone from the BCCA community and identified the type of job thy would like (53%). Again, the African American student participants reported a different experience where only two (40%) confirmed that they discussed future plans with someone from the BCCA community. In addition, only one African American student participant (20%) agreed with the statement that they identified the type of job they would like. This does not align with the intent of the professional development pillar and is an important finding from this research. These differences expressed by the African American student participants likely stymied their identity construction specifically their ability to try on identities and confirm who they wanted to become.

Finding 4: Student participants reported that the other student participants in the BCCA program had a primary role in supporting opportunities for identity development, helping them feel that they belonged in the community, with male student interviewees highlighting technical support and females highlighting both technical and emotional support from their peers.

While there were no questions regarding peer student support in the survey, the matter was consistently brought up by students during the interviews. As part of the interviews, student participants were asked how other students helped them in the program (Student Interview Guide, Appendix C). All seven student participants reflected that their peers helped their learning process as students. One point of distinction is that five of the seven student participants which were all male, indicated that other students translated the technical instruction into information that they could understand. In addition, the male students described the environment with their peers as one where they took turns sharing information on what they learned along with tips for the other students, depending on their individual understanding.

For example, one of the white male student participants described how their classmates were able to explain and share their learning to their peers to help gain a common understanding. In addition, he noted that once he completed his work he would check to see if there were classmates that may need additional support. This sentiment was echoed by an African American male student participant who described situations where he reached out for help from his peers and also provided help to his peers. Samples from several interview transcripts with male student participants are below.

> So when he explained something, we could completely not understand from his language, but we can, we can under, we can get the same job done if, um, you know, you ask the classmate and they explain it, you know, cause we're, like I said, we're all in kind of the same level. So when he's telling us to do something, um, it's a bit more complex than it is when, you know, a fellow student is trying to explain it to us from, you know, our, our low, lower level of, um, understanding. And yeah, we'll use some of the, sometimes you kind of tell sometimes who was, um, struggling a bit. And so, you know, like I said, some people, the community, you get kind of nervous asking questions because you don't want to be the only one in the class like that doesn't know as much. So, um, yeah, if I finished something early, I would, I would just go ask her if anybody needed help. (White male)

> We, um, kind of took turns on that there was, um, a couple of, um, subjects that we would touch on that I probably wouldn't get the hang of quickly, but my classmates would. So, you know, I would kind of, you know, walk over and sit down and be like, Hey, um, how did you understand this? Or how did you take it in and vice versa? Sometimes I would, I would understand it quickly. And, um, they would come to me and, you know, how, um, asked me how, how, uh, we got the hang of it so quickly. (African American male)

> Me and him really helped each other out through the whole year. (White male)

> You got to work together, help try to, you know, give each other a leg up, you know, just give each other a stepping stone. (African American male)

Both of the female student interview participants commented on the support that other students provided, however they also highlighted the emotional support that was shared in the community. For example, one of the African American female students described a close relationship with an African American male student where they provided each other support outside of the classroom. She recalled that they would take turns paying for each other's lunch, talk through problems, and give each other advice. The interview transcript that highlights this relationship is provided below.

> So, he was like the person that was there for me, the most of all people. And I think I helped him on as well, so that I think we helped each other a lot. We would study at home. We would study during lunch and I was kind of there for him to talk. He was there for me to talk about things. Um, so yeah, we would kind of like pay for each other's lunch here and there and just walk and talk and like let stuff out and then just give each other advice on how to move forward and what to do with this. And don't do that. That's, that's a bad decision and stuff like that. So that's kind of how we were. (African American female)

This supportive environment for students aligns with the programs goals of creating a caring learning community. In addition, this illustrates the important role that student participants had as they co-constructed their identities and explored whether they could be a software developer, and otherwise who they wanted to become during the program. This suggests that the BCCA environment served as a co-constructor of learning through peer support, which was impactful for female and male student participants. The male students, however, recalled peer support that focused on technical matters while the females recalled the holistic support which included technical instruction and ongoing peer support through personal relationships.

Figure 8: Summary of Research Questions, Data Collection, Key Findings

Research Question	Data Collection	Key Findings
1.How does student identity mediate the Connection phase in the BCCA program?	Nominator Survey Nominator Interviews Student Survey Student Interviews	1. Student participants do not have a clear understanding of the BCCA program before starting the program, which limits their opportunity to imagine themselves as a participant of the community and as a software developer.
2.How does student identity mediate the Entry phase in the BCCA program?	Student Survey Student Interviews	2. Female student participants reported lower academic confidence and described feeling concern about whether they belonged in the community when they started the program, a factor that can inhibit their perception that they are capable and have the skills to complete the work to become a software developer.
3.How does student identity mediate the Progress phase in the BCCA program?	Student Survey Student Interviews	3. African American student participants report a different experience in the professional development pillar compared to their peers regarding opportunities to learn from "others (like me) that have jobs in software development" and "others that had a similar background as me", a factor that may impact their perception of who they can become in the BCCA program and in the software development community.
	Student Interviews	4. Student participants reported that the other students had a primary role in supporting opportunities for identity development, helping them feel that they belong in the community, with male students highlighting technical support and females highlighting both technical and emotional support from their peers.

Recommendations

Recommendation 1: Provide student recruitment materials to nominators for distribution to students in surrounding school districts (high schools and middle schools) to help students develop a clear understanding of the program. Understanding of the purpose of the program, the goals, and the benefits can offer opportunities for students to try on an initial identity as a software developer and envision themselves as a participant in the BCCA community.

The marketing materials (i.e., public facing documents, website, social media) should focus on providing clarity on BCCA training and activities in language that prospective students will understand (i.e., "build a website", "create an app", etc.). This will establish a better understanding of the type of skills provided in the program and assist in the identity construction as they consider their future self as a potential participant in the BCCA program and eventual software developer. Similar strategies appear to be used by other coding academies. For example, BlackGirlsCode, a national nonprofit organization that provides coding instruction to African American girls in middle school through high school, describes the work completed in their hackathon events as "*learn to build apps*" (BlackGirlsCode.com). Another example includes the national nonprofit coding academy for high school girls, KodeWithKlossy. This organization describes their program by simply stating "*you'll learn to build a website, a mobile application or data visualization"* (KodewithKlossy.com). Similarly, the language used by another national nonprofit coding program, code.org, states "*learn to make your own game, app, or computer drawing"* and *"build real working apps, games and websites using blocks, JavaScript, CSS, HTML and more"* to describe the program for grades K-5 and grades 6-12, respectively (Code.org).

Finally, the content should focus on providing inclusive images and testimonials that students can relate to inclusive of their gender, racial, or ethnic identity. This early exposure to images that students can self-identify with is particularly important to African American female students during the connection phase. Former research regarding the ethnic prominence theory suggests that African American women have a higher sensitivity to racial discrimination compared to gender discrimination. Through their research study, Pietri, Johnson, & Ozgumus (2018) found that providing profiles of African American women and men were effective "identity safe cues" for African American women. This confirms the importance that images of successful African Americans in STEM can help to alleviate social identity threat (Pietri, Johnson, & Ozgumus, 2018).

Recommendation 2: Actively recruit women and African American software developers to serve as champions for the professional development activities (i.e., professional mentors, site visits, guest speakers) in order to offer greater representation to students whose identities are currently underrepresented in the software development field.

To better support women and African American students as they evolve their identity construction, it is important that they have access to professionals and role models that are identities currently underrepresented in the field. The Inclusive Design Research Centre asserts that "inclusive design is design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference" (IDRC.com). Using this definition, it is recommended that the broader BCCA stakeholder community (i.e., guest speakers, professional mentors, interview coaches) prioritizes representation that is inclusive of women and African Americans. This is particularly important for the BCCA community members that students will interact with for extended amounts of time as they will likely serve as software developer role models. For example, the BCCA professional mentors assigned to support students should include this inclusive representation, so that the students whose identities are currently underrepresented in the software development field are accessible in the form of role models.

Through their research which expands on the social identity theory, Del Carpio & Guuaduple (2019) introduce the concept of "identity wedge". This phenomenon is described as differences that prevent doing something due to social identity norms due to the psychological costs for individuals who do not fit within the societal norms. Through two different controlled experiments in Latin America, they found that social identity bias could be overcome as demonstrated through enrollment into a free technology coding academy program. The key factors that helped overcome social identity bias in technology for women included: having female role models, demonstrating probability of success, and communicating the development of a network and connections with the STEM field (Del Carpio & Guuadulpe, 2019).

Another research study that echoes the positive impact of pairing female STEM students with female mentors was completed by Dennehy & Dasgupta (2017). Through a longitudinal study of female engineering students, they found that "women with female mentors reported more stable feelings of belonging in engineering over time than others with male mentors" and that "belonging in turn predicted increased intentions to pursue an engineering career" (Dennehy & Dasgupta, 2017, pg.5966). Finally, this research concluded that for female students "same-gender peer mentoring during the transition to college appears to be an effective intervention to increase belonging, confidence, motivation, and ultimately retention of women in engineering" (Dennehy & Dasgupta, 2017, pg.5968).

Limitations

There are several limitations to this research project. The data collected focused on the first four cohorts. As such, there is no student data from those in the current cohort, and this analysis does not account for any revisions to the program that were put in place after May 2020. Another limitation is that participants were limited to those with a valid email address. As such, students and nominators where there was not a valid email address available were not able to be contacted.

The sample size was small for this research project and did not allow for inferential statistical analysis. Third, the data collected relies primarily on feedback from students that completed the program, as students that did not complete the program had very limited participation in the student survey (2 of the 15 participants) and no participation in the student interviews. Finally, due to the COVID 19 Pandemic, data collection was limited to virtual forms of communication (i.e., online survey, Zoom interviews). In person interviews and survey completion was prohibited due to the social distancing mandates in place during the time this research project was completed.

Conclusion

The purpose of this investigation was to explore the factors that may mediate identity construction as students learn about and participate in the free twelve-month technology training program and provide recommendations on how the organization can improve retention for African American and female students. The findings suggest that almost half of the student participants did not understand the program (or program goals) before starting class which limits their ability to imagine themselves as a member of the community. There is an opportunity to better communicate the program to nominators and prospective students by providing a clear description of the technical training they will receive. This will assist students as they evolve their identities during the Connection phase where they envision themselves as a participant.

In addition, the findings suggest that female participants reported a lower academic confidence and described feeling concern about whether they belonged in the community when they started the program, a factor that can inhibit their perception that they are capable and have the skills to complete the work to become a software developer. African American student participants reported a different experience in the professional development pillar compared to their peers regarding opportunities to learn from “others (like me) that have jobs in software development” and “others that had a similar background as me”, a factor that may impact their

perception of who they can become in the BCCA program and in the software development community. To help address these two findings, there is an opportunity to provide a more inclusive environment, specifically for those groups that are currently underrepresented in the software developer field. This will better support these students as they complete identity work to determine if they belong and who they can become. These recommendations have the potential to improve the completion rates of women and African American students that enroll in the program.

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APPENDIX A: Semi-structured Interview Questions, BCCA Staff

1. Describe your role at BCCA.
2. Do you feel comfortable with the nominations process? Why / Why not?
3. What are things you look for in students admitted to BCCA?
4. What challenges have you seen with students completing the program?
5. What type of support does BCCA provide students?

APPENDIX B: Semi-structured Interview Questions, BCCA Nominators

1. How did you learn about BCCA?
2. What do you look for in students that you nominate for BCCA?
3. Do you discuss the student nominations with other faculty members?
4. What is the process you use to identify students that you nominate?
5. Do you discuss the program with you students?
6. How do you describe the program to students?
7. Have you ever been to visit BCCA?

APPENDIX C: Nominator Survey Questions

Survey Tool: Qualtrics

Q1 - How did you learn about Base Camp Coding Academy?

I heard someone speak about Base Camp
Someone from my school told me about Base Camp
Student
Trip to visit Base Camp
Other (Please specify)

Q2 - How many students have you nominated for Base Camp Coding Academy?

1 to 3
3 to 5
5 to 7
More than 7

Q3 - What are the three primary traits that you look for when nominating a student for Base Camp Coding Academy?

_____

Q4 - How do you describe Base Camp Coding Academy to students that you may nominate?

_____

Q5 - Do you typically discuss potential student nominations with other faculty members?

Yes
Sometimes
No

Q6 - When do you start discussing Base Camp Coding Academy with students?

Senior Year
Junior Year

Sophomore Year
Freshmen Year

Q7 - Do you know any students that graduated from Base Camp Coding Academy?

Yes
No

Q8 - Do other faculty members at your school nominate students for Base Camp Coding Academy?

Yes
No

Q9 - What would be most helpful to gain student interest in Base Camp Coding Academy? (Can Select more than one)

School visits from Base Camp to discuss program
Information / handouts about BaseCamp program
Student visits / field trips to Base Camp to learn about program
Videos that can be shared during class about Base Camp
Other (please specify)_____

Q10 - What feedback do you have to improve the nomination process?

_____

APPENDIX D: Former BCCA Students, Semi-structured Interview Questions

1. How did you learn about BCCA?
2. What did you think when you started the program? What was your first impression?
3. How did you see yourself at the start of the program?
4. Why did you enroll in the program?
5. What were your expectations of the program? How did they change?
6. How did you change while at BCCA?
7. When thinking about your time at BCCA, what experiences stand out?
8. Did other students help your progress in the program?
9. Describe a typical week during your enrollment at BCCA.
10. What helped you the most while you were enrolled at BCCA?

APPENDIX E: Survey Questions: BCCA Former Student Survey

Survey Tool: Qualtrics

Q1 - What age were you during enrollment at BaseCamp?

18

19

20

Other

Q2 - What year were you enrolled in BaseCamp?

Class of 2017 (year 1)

Class of 2018 (year 2)

Class of 2019 (year 3)

Class of 2020 (year 4)

Q3 - Did you graduate from BaseCamp?

Yes

No

Q4- Please select your gender

Male

Female

Q5 - Please select your race / ethnicity

White

Other

Hispanic

Asian

African American

Q6 - Please enter the name of the high school you attended

_____

Q7 - Please select what best describes your mother's education level

Some High School

High School Graduate

Some College

College Graduate

Q8 - Please select what best describes your father's education level

Some High School

High School Graduate

Some College

College Graduate

Q9 - Please select what best describes your sibling's education level

Some High School

High School Graduate

Some College

College Graduate

Q10 - Please select what best describes your family's income (before taxes)

$40,000 to $60,000 per year

$20,000 to $40,000 per year

More than $60,000 per year

Less than $20,000 per year

Q11 - Did you have a job during your enrollment at Basecamp?

Yes

No

Q12 - How many hours did you work at your job during your enrollment at BaseCamp?

20 to 40 hours per week

10 to 20 hours per week

40 hours or more per week

10 hours or less per week

Q13 - Did you live at home with your parents (or family) during your enrollment at BaseCamp?

Yes

No

Q14 - Did you receive financial support from your parents (or family) during your enrollment at BaseCamp?

Yes

No

Q15 - Were you married during your enrollment at BaseCamp?

Yes

No

Q16 - Did you have children during your enrollment at BaseCamp?

Yes

No

Q17 - How did you learn about BaseCamp?

Teacher / Coach / Counselor

Other

Family

Q18 - What did you know about BaseCamp before starting the program?

_____

Q19 - What was your Grade Point Average (GPA) during high school?

2.5 or below

2.5 to 3.0

3.0 to 3.5

3.5 to 4.0

Q20 - How do you rate yourself in school ability compared with your close friends?

I am the best

I am above average

I am average

I am below average

I am the poorest

Q21 - How do you rate yourself in school ability compared with those in your BaseCamp class?

I am the best

I am above average

I am average

I am below average

I am the poorest

Q22 - Do you think you have the ability to complete college?

Yes, definitely

Yes, probably

Not sure either way

Probably not

No

Q23 - Where do you think you would rank in your class in college?

Among the best

Above average

Average

Below average

Among the poorest

Q24 - Forget for a moment how others grade your work. In your opinion, how good do you think your work is?

My work is excellent

My work is good

My work is average

My work is below average

My work is much below average

Q25 - What kind of grades do you think you are capable of getting?

Mostly Fs

Mostly Ds

Mostly Cs

Mostly Bs

Mostly As

Q26- During my time at BaseCamp, my instructors....

Question	Almost Never	Sometimes	Often	Almost Always
Were available outside class at times convenient to me				
Were easy to talk to				
Had trouble understanding the students' problems				
Focused their instruction to students interests and abilities				
Were unable to explain something in a way I could understand it				
Respected students' points of view different from their own				
Treated all students fairly				
Were clear about what they expect of students				

Q27 - During my time at BaseCamp, I had times where,

Question	Almost never	Sometimes	Often	Almost Always
I was bored in class				
I was in a class that went over material I already knew				
I felt frustrated because the class was going too fast				
I felt frustrated because the class was going too slow				
I needed additional support to complete my work				
I completed assessments to show I understand the assignments				
I made a presentation to my class				
I prepared two or more drafts of assignment before turning it in				
I worked on an assignment that required support from my classmates				
I worked with other students to complete a project in class				
I worked with other students to complete a project outside of class				
I worked harder than I thought I could to meet an instructors standards / expectations				
I had to miss class because of work				
I had to miss class to help my family				

Q28 - Please select statements that apply to your experience at BaseCamp. During my time at BaseCamp,

I talked to someone at BCCA about my future plans		
I learned about possibilities for a job when I finish the program		
I learned from others that currently have jobs in software development		
I met with other BaseCamp graduates that have jobs in software development		
I learned from others (like me) that have jobs in software development		
I identified what type of job I would like		
I identified a company I would be interested in joining		
I visited companies to understand job opportunities in software development		
I had networking opportunities to meet others that work in software development		
I had opportunities to meet with professionals that were like me		
I had opportunities to learn from others that had a similar background as me		

APPENDIX F: Former Student Survey Reponses, Questions 20 - 21 (by Gender)

		Total	Male	Female
What was your Grade Point Average (GPA) during high school?	2.5 or below	0.0	0.0	0.0
	2.5 to 3.0	4.0	3.0	1.0
	3.0 to 3.5	5.0	3.0	2.0
	3.5 to 4.0	6.0	3.0	3.0
	2.5 or below	0.0%	0.0%	0.0%
	2.5 to 3.0	26.7%	33.3%	16.7%
	3.0 to 3.5	33.3%	33.3%	33.3%
	3.5 to 4.0	40.0%	33.3%	50.0%

		Total	Male	Female
How do you rate yourself in school ability compared with your close friends?	I am the best	2.0	1.0	1.0
	I am above average	7.0	7.0	0.0
	I am average	5.0	0.0	5.0
	I am below average	0.0	0.0	0.0
	I am the poorest	0.0	0.0	0.0
	I am the best	13.3%	11.1%	16.7%
	I am above average	46.7%	77.8%	0.0%
	I am average	33.3%	0.0%	83.3%
	I am below average	0.0%	0.0%	0.0%
	I am the poorest	0.0%	0.0%	0.0%

		Total	Male	Female
How do you rate yourself in school ability compared with those in your BaseCamp class?	I am the best	2.0	1.0	1.0
	I am above average	7.0	7.0	0.0
	I am average	4.0	0.0	4.0
	I am below average	1.0	0.0	1.0
	I am the poorest	0.0	0.0	0.0
	I am the best	13.3%	11.1%	16.7%
	I am above average	46.7%	77.8%	0.0%
	I am average	26.7%	0.0%	66.7%
	I am below average	6.7%	0.0%	16.7%
	I am the poorest	0.0%	0.0%	0.0%

APPENDIX G: Former Student Survey Responses, Q28 (By Gender & Ethnicity)

		Total	Male	Female	Total	White	Asian	Hispanic	Other	African American
Please select statements that apply to your experience at BaseCamp. During my time at BaseCamp,	I talked to someone at BCCA about my future plans	**66.7%**	55.6%	83.3%	**66.7%**	71.4%	0.0%	100.0%	100.0%	40.0%
	I learned about possibilities for a job when I finish the program	**80.0%**	77.8%	83.3%	**80.0%**	71.4%	0.0%	100.0%	100.0%	80.0%
	I learned from others that currently have jobs in software development	**86.7%**	77.8%	100.0%	**86.7%**	100.0%	0.0%	100.0%	100.0%	60.0%
	I met with other BaseCamp graduates that have jobs in software development	**80.0%**	77.8%	83.3%	**80.0%**	71.4%	0.0%	100.0%	100.0%	80.0%
	I learned from others (like me) that have jobs in software development	**80.0%**	77.8%	83.3%	**80.0%**	100.0%	0.0%	100.0%	100.0%	40.0%
	I identified what type of job I would like	**53.3%**	55.6%	50.0%	**53.3%**	71.4%	0.0%	100.0%	0.0%	20.0%
	I identified a company I would be interested in joining	**80.0%**	88.9%	66.7%	**80.0%**	85.7%	0.0%	100.0%	0.0%	80.0%
	I visited companies to understand job opportunities in software development	**93.3%**	88.9%	100.0%	**93.3%**	100.0%	0.0%	100.0%	100.0%	80.0%
	I had networking opportunities to meet others that work in software development	**93.3%**	88.9%	100.0%	**93.3%**	100.0%	0.0%	100.0%	100.0%	80.0%
	I had opportunities to meet with professionals that were like me	**80.0%**	88.9%	66.7%	**80.0%**	85.7%	0.0%	100.0%	100.0%	60.0%
	I had opportunities to learn from others that had a similar background as me	**66.7%**	66.7%	66.7%	**66.7%**	71.4%	0.0%	100.0%	100.0%	40.0%

		Gender			Ethnicity					
		Total	Male	Female	**Total**	White	Asian	Hispanic	Other	African American
Please select statements that apply to your experience at BaseCamp. During my time at BaseCamp,	I talked to someone at BCCA about my future plans	**10.0**	5.0	5.0	**10.0**	5.0	0.0	2.0	1.0	2.0
	I learned about possibilities for a job when I finish the program	**12.0**	7.0	5.0	**12.0**	5.0	0.0	2.0	1.0	4.0
	I learned from others that currently have jobs in software development	**13.0**	7.0	6.0	**13.0**	7.0	0.0	2.0	1.0	3.0
	I met with other BaseCamp graduates that have jobs in software development	**12.0**	7.0	5.0	**12.0**	5.0	0.0	2.0	1.0	4.0
	I learned from others (like me) that have jobs in software development	**12.0**	7.0	5.0	**12.0**	7.0	0.0	2.0	1.0	2.0
	I identified what type of job I would like	**8.0**	5.0	3.0	**8.0**	5.0	0.0	2.0	0.0	1.0
	I identified a company I would be interested in joining	**12.0**	8.0	4.0	**12.0**	6.0	0.0	2.0	0.0	4.0
	I visited companies to understand job opportunities in software development	**14.0**	8.0	6.0	**14.0**	7.0	0.0	2.0	1.0	4.0
	I had networking opportunities to meet others that work in software development	**14.0**	8.0	6.0	**14.0**	7.0	0.0	2.0	1.0	4.0
	I had opportunities to meet with professionals that were like me	**12.0**	8.0	4.0	**12.0**	6.0	0.0	2.0	1.0	3.0
	I had opportunities to learn from others that had a similar background as me	**10.0**	6.0	4.0	**10.0**	5.0	0.0	2.0	1.0	2.0