

LEADERSHIP IN PRACTICE

Exploring the Intersectionality of Problem-Solving Preferences, Expressed Behaviors, and Identity Upon Academic Degree Matriculation, Through the Cognitive Socio-Behavioral Perspective Lens

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This manuscript introduces the Cognitive Socio-Behavioral Perspective (CSBP) to analyze cognitive and psycho-social dynamics in African American males pursuing STEM and agriculturally-related degrees. While motivation, problem-solving, critical race theory, and identity are common research themes, their integration into student retention remains limited. Drawing from adaption-innovation theory, critical race theory and the organismic socio-behavioral perspective, the CSBP model explores the reciprocal nature of these processes and addresses African American underrepresentation in STEM. The study delineates four key themes: motivational factors and retention challenges, belonging experiences, mentorship as coping, and navigating multiple identities in STEM. These themes emphasize the need for tailored retention strategies and culturally competent mentorship to support African American males in STEM education and workforce participation, offering insights for policy and practice.

Introduction

Motivation, problem-solving, critical race theory, and identity research are common topics in many areas of education and social science research (R. A. Scott & Kosslyn, 2015). The salience of each of these research fields is critical to student development, retention, and success. However, few studies have integrated the application of these respective fields into student retention and success practices. As a result, the understanding of their reciprocal nature and their influences or impacts on student development are not sufficiently understood.

To better understand the cognitive and psycho-social relationships between identity, persistence, motivation, and problem-solving, we developed the *cognitive socio-behavioral perspective* (CSBP) conceptual framework, which draws upon theories of adaption-innovation, critical race theory, and emerges from Anderson et al.'s (2018) organismic socio-behavioral perspective. The primary focus of this article is to introduce the CSBP model and apply it to understanding the processes that impact African American males in

pursuit of undergraduate degrees in science, technology, engineering, and math (STEM) and agriculture-related programs by addressing the following research questions:

1. Do African American males feel a sense of belonging within STEM degree programs?
2. What coping behaviors do African American males exhibit within STEM degree programs?

Background

A growing need for a skilled STEM workforce has led to several initiatives promoting STEM degree attainment including the “*Raise the Bar: STEM Excellence for All Student Initiative*” by the U.S. Department of Education and business and organization initiatives such as LEGO’s, “*Championing STEM Initiatives*” programs. Disciplines within the field of career and technical education (CTE), such as agricultural education, often include STEM-intensive coursework and, for the purposes of this study, are recognized as branches of STEM. There is a significant need for STEM literate professionals; however, the number of students entering and completing STEM degrees has not been on par with the number of available positions, resulting in a worker shortage (Diekman & Benson-Greenwald, 2018), suggesting a troubling inability at the global scale to meet changing workforce needs in a timely manner. At present, the majority of STEM and CTE degree holders are White, Asian, and male, demonstrating inequitable racial and ethnically diverse representation within these fields (Grieco & Deitz, 2023). To counteract both worker shortage and disparities in equitable representation, it is imperative that we explore the issues that impact the development of a diverse workforce that is inclusive of ethnic and gender minorities.¹

African American Representation

STEM and agriculture represent some of the fastest growing employment sectors within the U.S. workforce (Mulvey et al., 2023). In addition to a well-documented skills gap between potential employees and employers, the representation of ethnic and gender diversity remains disproportionately lower within these fields (Grieco & Deitz, 2023). Murphy et al. (2022) found that diversity is an important factor contributing to the innovation needed to address challenges within society.

The issues impacting the recruitment and retention of diverse talent into STEM fields can be traced to issues within the K–12 educational system, including the lack of science exposure for African American students at

¹ Science, technology, engineering, the arts, and mathematics.

critical transition points, such as when students begin to consider and decide upon future career and educational trajectories. Limited access, exposure, and understanding of STEM, along with a lack of diverse representation, has negative implications for the development of a positive STEM identity (Brown et al., 2017; Dou et al., 2019; García et al., 2019). This is further compounded by existing educational disparities within African American communities, with African American males less likely to pursue and complete higher education than other demographic groups (Bridges, 2020; Wint et al., 2021).

Materials and Methods

This study was completed as part of a dissertation project. The authors are representative of diverse backgrounds and all serve as faculty members at universities within the southeastern part of the United States. They have combined expertise in experiential learning, problem-solving, liberation, policy, and culturally responsive pedagogies.

The factors influencing the persistence and retention of African American males within STEM degree programs are complex and require an understanding of the co-influential and intersectional nature of cognition, identity, and environment. To explore these interactions, we used Kirton's (2011) cognitive function schema to examine problem-solving styles and Anderson et al.'s (2018) organismic socio-behavioral perspective (OSBP) to describe the interrelationship between constructs of identity, behavior, and environment through the lens of critical race theory (CRT) (Delgado & Stefancic, 2017). Within this framework, CRT allows us to explore the pervasiveness of race within historical and contemporary contexts. Kirton's schema, overlain with OSBP and CRT, informed the creation of the Cognitive Socio-Behavioral Perspective (CSBP), which serves as the conceptual framework for this study. Using social media and email listserv, we recruited from a convenience sample of African American male students enrolled at both Historically Black Colleges and Universities (HBCUs) and Predominantly White Institutions (PWIs). Ten individuals elected to participate. We conducted a qualitative thematic analysis of the data. Appendix [Table 1](#) describes participant demographics.

Cognitive Socio-Behavioral Perspective (CSBP)

The cognitive socio-behavioral perspective (CSBP) examines the cognitive processes of problem-solving and motivation as they relate to identity, environment, and behavior. This integrated conceptual model was developed by Simpson (2019) as part of her doctoral dissertation. It builds upon Anderson et al.'s (2018) OSBP model and Kirton's (2011) cognitive function schema, viewed through a CRT lens to account for the systemic normalization of race and the barriers associated with racism (Delgado & Stefancic, 2017). These concepts create an integrated approach to educational

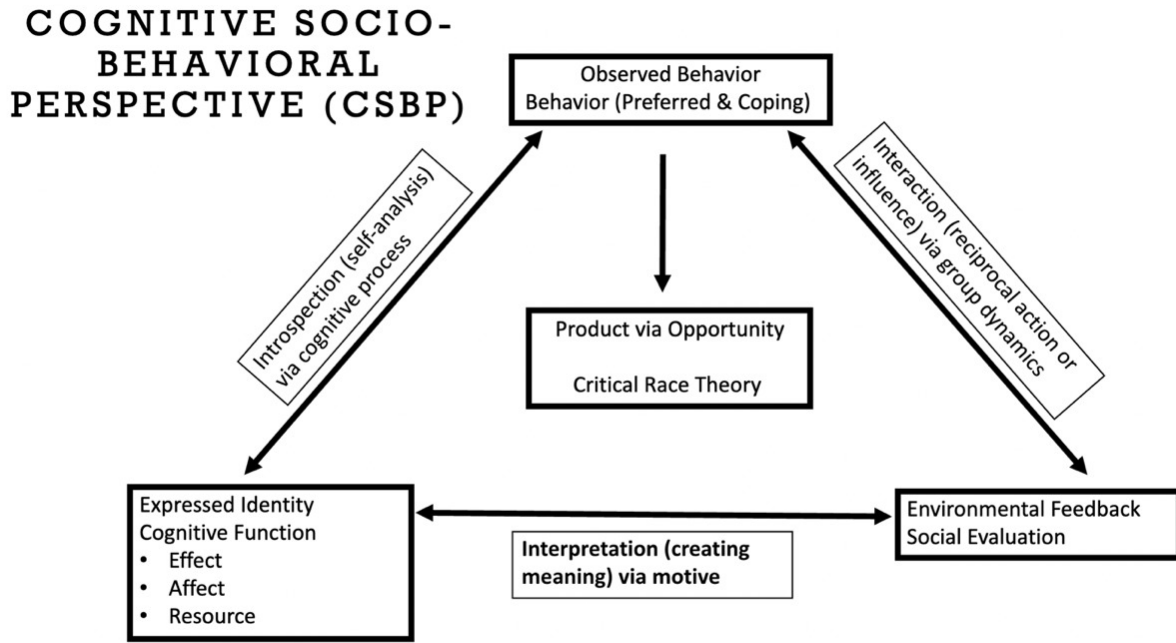


Figure 1. Cognitive Socio-Behavioral Perspective (CSBP)

interventions for Black, Indigenous, and Persons of Color (BIPOC) students by probing the intersectional relationships between student identity, cognitive function, and race.

Interaction, Introspection, and Interpretation

Interaction, introspection, and interpretation work together to inform the CSBP model. Interaction refers to the interchange between the person and their environment (Anderson et al., 2018). This construct posits that one changes or adjusts one's behavior based on one's perceptions of the environment. Introspection refers to the assessment of how one's identity correlates with actions to achieve desired results (Anderson et al., 2018). This posits that one's expressed identity is influenced by cognitive function, including one's needs, values, attitudes, and beliefs, which influence one's expressed behaviors (Kirton, 2011; Woods-Wells, 2016). Interpretation refers to the interaction of expressed identity and environmental feedback based on one's interpretation of one's environment. The functions of the OSBP are inclusive of the processes associated with each domain of Kirton's (2011; Anderson et al., 2018) cognitive function schema.

Identity

Identity is an ever-evolving concept impacted and influenced by perceptions, environment, interactions, and behaviors. Identities can be both collective and individual and they denote expected identity-based roles or behaviors (Carter & Fuller, 2016; Josselson & Harway, 2012; S. Scott, 2015). The development of a STEM identity is salient to improving the self-efficacy of STEM and agriculture programs. Flowers et al. (2019) determined that

self-efficacy is essential to the development of a science identity and that successful achievement in math or science courses at secondary level correlates both with an increased likelihood of selection and persistence in a STEM degree program and to a sense of belonging, (or perception of fit) within the STEM university setting (see Belanger et al., 2020). Similarly, exposure to mentoring relationships and role-modeling by persons from similar backgrounds are significant in the development of STEM identity and in increasing a sense of belonging. For the purposes of this study, STEM identity is defined as envisioning oneself as a person who utilizes, understands, and/or contributes to a STEM discipline (Dou et al., 2019; Singer et al., 2020).

Problem-Solving

Within the context of this research, problem-solving preference is operationalized by adaption-innovation (A-I) theory (Kirton, 2011), which provides insight into the ways individuals manage both problems and change. This theory suggests that one's problem-solving style is not related to many demographic factors, such as race, ethnicity or culture. However, increased diversity within groups is often difficult to manage, but it allows for more diversity of thought to enable complex problem-solving. It also posits that working in contrast to one's preferred problem-solving style causes behaviors that are indicative of coping. Coping behaviors (Kirton, 2011) include the use of adaptive or innovative skills to complete tasks. This is fueled by motivation, and becomes more stressful the greater intensity and longer the duration that the individual chooses to cope. Kirton's Adaption-Innovation Inventory (KAI) can be used to operationalize or measure one's preferred problem-solving style, as it relates to A-I theory. One's KAI score is comprised of three sub-scores: sufficiency of originality or idea generation (SO), methodology or efficiency (E), and management of structure or rule group conformity (R) (Kirton, 2013). According to A-I theory, any problem undertaken by two or more people consists of two problems: Problem A is the problem to be solved and Problem B is the problem of deciding how best to work together. Problem B can inhibit the resolution of Problem A. In this study, entering and completing a STEM-related degree program serves as Problem A, while factors inhibiting degree completion serve as Problem B.

Results

We utilized analytic induction and constant comparative analysis to analyze the data. Analytic induction allows for the determination of relationships between events or factors; constant comparative analysis is the coding and recoding of data to determine the emergence of relationships between themes (Glaser, 1965; Katz, 2002). We open-coded and focused coded the interview transcripts, using pseudonyms to protect participant confidentiality. Member-checking ensured the trustworthiness and reliability of the data. Four themes emerged from the focused codes: 1) motivational factors and challenges to attrition; 2) experiences impacting sense of belonging; 3) mentorship as evidence of coping; and 4) navigating multiple identities in STEM.

Theme 1: Motivational Factors and Challenges to Retention

Participants described the issues impacting retention, including their motivations for continuing their degrees and the barriers they believe may hinder them and others from degree completion. The participants, in general, positively perceived successful degree completion and achieving their career goals. For example, Shyheim, a traditional student at a PWI majoring in environmental sciences said, “It’s only a matter of time, but I feel like I’m pretty confident that I’ll reach that goal.” He stated that the likelihood of reaching his goals after graduation was “95%.” However, Malik, a non-traditional student at a PWI, was less certain, stating that reaching his goals was “somewhat likely,” based on concerns related to his age, health, and finances. Xavier also expressed some doubts about completing his degree: “On a scale of one to ten, currently, I’m sort of a two, I mean four.” He related this lack of belief to being a first-year student and to his need to develop more skills and meet more people.

Positive perceptions about degree completion were most often associated with extrinsically motivating factors. In addition to financial stability, participants indicated a motivating desire to make a difference in their communities through technological development and service.

Participants described challenges when communicating with leaders, which negatively impacts their social capital. Xavier felt that leaders viewed him through a deficit perspective, and described experiences of being overlooked or having his intelligence underestimated.

HBCU students reported challenges when trying to develop a rapport with faculty leaders that would make space for the acceptance of personal identities, that included the personal backgrounds or domestic situations play in those interactions. These examples indicate a desire by students to connect with leaders outside the classroom to facilitate deeper relationships and provides evidence of the impact of the perceived nature of these relationships and interactions on students’ self-image, their perceptions of how they are viewed by their peers, and their beliefs in their own abilities to persevere in their degree programs. The also offer insights into where more student support is needed. These findings highlight the importance of developing relationships that support the growth of social capital between leaders and students, thus encouraging a strong STEM identity among students. The students in this study all reported feeling that their leaders do not understand their backgrounds or the issues they face. However, HBCU students seemed more confident than their PWI counterparts in approaching individuals in leadership roles.

Theme 2: Experiences Impacting Sense of Belonging

The participants recognized several issues that negatively impacted their degree program experiences, related to building and sustaining positive leader and peer relationships.

They indicated that first interactions with STEM information created the impetus to pursue undergraduate STEM degrees. While most participants had some STEM exposure at an early age, this was generally informal and, at the time, they did not recognize it as STEM. Participants became aware of STEM through individual research, connecting their hobbies and interests to STEM, or learning about STEM from someone external to their household. Malik said, “I would say probably a lot of [the desire to follow a STEM path] came from cartoons growing up. I always... really identified with the scientific genius characters, you know how they could create anything or solve any problems. I was really into... fantasy and magic and that sort of stuff. The closest thing that comes to that in real-life would be scientists being able to create things, and solve problems, and make solutions out of seemingly impossible problems.” Meanwhile, Omar, a traditional student majoring in engineering at a PWI, described incidences which impacted his sense of belonging: “Knowing that you are the only person who looks like you in the program.... it feels too much pressure. I mean, sometimes I would not perform as well... Sometime I start questioning myself, some sort of self-doubt that maybe it’s because I’m African American, things like that. Even whenever I would go to seek...advice, sometime I feel kind of uncomfortable that it’s going to reflect to our race that we are not as competent or competitive as others. So, I try to solve issues or problems on my own before going to faculties and stuff like that.”

Key factors that contributed positively to the student experience included interest in STEM, developing relationships, and being involved in STEM or other activities that enhanced the sense of belonging. The participants reported being connected to extracurricular, on-campus organizations related to their cultures, majors, or career goals. However, most described their level of participation within these organizations as declining as they matriculate further into their degree programs. This decline in participation can cause conflict between a student’s developing STEM identity and their personal identity, as they are forced to choose one community over the other in pursuit of success. A decline in extracurricular participation detaches the student from supportive communities and may cause feelings of loss or denigration of identity, as the student is forced to choose one group over the other, due to workload and other constraints. In contrast, this might also suggest that students who are new the university are in greater need of organizations and societies; while students more advanced in their degree programs have developed friendships and other support groups, have a greater sense of place within their program of study and are less in need of organizations to find meaning and support.

Theme 3: Mentorship as Evidence of Coping Behaviors

Mentorship is often perceived as a principal factor impacting student success, especially for historically minoritized groups with limited exposure to STEM. When asked about their experiences being mentored, all but one identified faculty leaders as mentors and many participants described teaching

–relationships with leaders and advisors. These responses reveal students’ dual expectations of faculty as both mentors and instructors, exposing the student belief that faculty leaders are mentors regardless of student-faculty leader relationship outside of the classroom.

Tyrik, a traditional student majoring in natural resources and environmental design at an HBCU, was seeking a mentor during his participation in the study. He defined the role as: “Somebody that’s been through what I’ve been through and can help me get through it.” He described being approached by a course leader of Asian descent, who invited him to work in a lab doing undergraduate research. This faculty leader’s attempt to act in the capacity of a mentor went unrecognized or unwanted by Tyrik and he described a preference for an African American mentor who could better understand the challenges the student faced as an African American male student.

Study participants associated mentorship with positive social capital, motivation, and success. They had varying perceptions of mentorship; however, all desired or perceived a mentor as someone who would advise them on the best practices to navigate the social pressures and social expectations associated with achieving success in the STEM environment. None of the participants expressed apprehension concerning assignments or tasks; rather, they sought mentorship that would help them to make the correct decisions to meet their career goals. Based on the researcher’s knowledge of the preferred problem-solving styles of these students, and the issues they described, participant statements indicated that the desire for mentorship may also be a form of coping behavior that helps students to overcome soft-skill or relational barriers (problem B) to building social capital that allows to better perform the technical tasks required of a degree program (problem A). While the formulation of positive relationships with faculty, or mentorship, is correlated with positive outcomes, student-faculty interaction is influenced by race and gender. As such, negative student-faculty interactions and racialized experiences, some of which were reported by study participants, can result in the development of negative social capital and have negative impacts on the educational experience and on future career trajectory (Salazar et al., 2019). At university, these students often operate in a culture very different to their home cultures, leading them to expend energy seeking support in how to navigate, pursue, and cultivate relationships to assimilate into STEM culture. They do so by becoming members of professional or affinity groups, which help them to affirm their place and sense of belonging in their degree program.

Theme 4: Navigating Multiple Identities in STEM

The participants in this study occupied and navigated multiple roles and identities, including as students, African Americans, immigrants, peers, employees, and more. The different responsibilities and behaviors required to navigate these multiple identities can cause inner conflict when the responsibilities associated with different roles are contradictory. Antonio, a

non-traditional HBCU student and full-time tobacco farmer majoring in agricultural education, described the difficulty of completing assignments and attending class as these sometimes conflicted with his farming duties, specifically when the latter were driven by weather patterns or unforeseen tasks farm-related tasks. Although his course leaders identified with agriculture, they did not always understand his responsibilities as a farmer and household. As a result, his identity, and his dual responsibilities as a farmer and a student produced conflict despite his pursuit of a degree that was in line with his profession. He hoped that his educational leaders and instructors would understand the issues that arise when farming. Similarly, Roy, a traditional student majoring in engineering at a PWI described the need to change or conform to be successful in his degree program: “I guess to some extent you do have to change...your mindset or the way you approach things, because not everybody may have the positive, go ahead, can do attitude... I guess you have to conform to something...” The participants described working to assimilate to STEM culture and sometimes feeling disconnected or ostracized from others in that culture. Identifying with one’s degree program or career field has important implications for retention. Although the participants identified as STEM students, they expressed greater difficulty envisioning themselves as STEM professionals or as successful STEM students. Such self-perception can greatly impact the development of STEM identity and demonstrates the turmoil that can arise when attempting to reconcile multiple personal identities.

The participants described intersectional identities that encompass race, gender, and roles both internal and external to academia, including club membership, provider roles, and more. Of the roles described, race seemed to have the most prevalent impact on navigating the STEM environment; however, for non-traditional students, financial obligations and provider roles were also salient. These identities are often not found among college students and they present specific conflicts that leaders are not equipped to handle.

Discussion

The four themes form part of the conceptual model and demonstrate the participants’ introspection, attitudes, values, and beliefs (cognitive affect) and how the processes associated with cognitive affect influence their behavior (motivation to complete their degrees) in the environment. The study participants expressed their motivation to succeed in matriculating through their degree programs, despite receiving negative feedback from their environments relating to perceptions of inadequacy and their roles as both consumers and purveyors of knowledge. These factors played a significant role in the participants’ expressed identities and in the coping behaviors they employ.

The participants’ narratives highlighted their unique experiences in developing their STEM identities. Their experiences provide counter-narratives to negative stereotypes about African American men (e.g., apathy toward education and criminality), highlighting individual strengths,

motivations, and tenacity to succeed despite racist and other barriers that have the potential to derail individuals from completing their degree programs. Each participant had different ideals associated with STEM identity and success. This discussion further contributes to counter-narratives about the ability of African American men to succeed in higher education, specifically within STEM. It questions a ‘one size fits all’ approach to recruiting and retaining minoritized persons in STEM and suggests the need for more individualized retention strategies (Gisler et al., 2018). The CSBP model assists in creating more bespoke recruitment and retention strategies by incorporating problem-solving preferences and cultural awareness, thus supporting the sense of belonging into the student recruitment and retention of BIPOC populations.

Environmental feedback and social effect play important roles in the ways students create meaning and how that meaning validates or invalidates their expressed identity and cognitive processes. A greater understanding of the interactions between these cognitive processes and of the power dynamics between BIPOC students and leaders can help to create a more inclusive culture of belonging by minimizing the arenas in which these students must cope.

Summary

This study explored present and historical influences of race and perceptions of race on the development of STEM identity through the lens of critical race theory. The resulting experiences of African American men in STEM serve as a counter-narrative to negative stereotypes perpetuated about this group. The study facilitated a better understanding of student experiences of STEM identity development, revealing a lack of mentorship to assist students’ socio-political navigation, students’ desire to prove themselves as deserving of entrance into STEM programs, and a lack of cultural awareness among STEM leaders.

While race was not viewed as a prevailing factor negatively impacting experiences, some participants acknowledged that it impacted the ways in which they believe they are perceived by others. However, the participants may have been operating within a paradigm of colorblindness, viewing some of their racialized experiences as normative STEM experiences (Whitley et al., 2023). Motivational factors were apparent in participant narratives as they described coping to overcome issues related to degree attainment and overcoming taxing situations based on their desire to reach their goals. These factors are evidenced through the OSBP and can be utilized to describe the story of African American men in STEM degree programs.

Through the CSBP framework, we can see that an individual’s observed behavior is cognitively evaluated and regulated through the introspection of their expressed identity, which includes, but is not limited to, cognitive effect (problem-solving style and academic level), cognitive affect (subscription to STEM and Black identities), and cognitive resources (knowledge retained that will help the individual reach their goals). The academic motivation

to engage in STEM-oriented activities (observed behavior) is a product of the individual's interpretation of how the environment accepts and values their expressed identity based on the environmental feedback they receive (Anderson et al., 2018; Kirton, 2013).

Data from this study align with the conceptual framework, as cognitive function/expressed identity are influenced by environmental feedback or social effect causing the individual to interpret or create meaning via motive. This process of coping continues based on a student's motive or desire to succeed, but also impacts their sense of belonging as they interpret the role and value of their expressed identity based on environmental feedback. The CSBP model provides a cognitive lens for understanding a diversity of problem-solving preferences and the ways in which individual behaviors and identity are influenced by the environment. As the individual is forced to problem-solve in ways that differ from their accustomed problem-solving style, they adapt to function outside of that preferred style, resulting in the experience of duality. This duality requires the individual to see and measure himself through the eyes of others, which conflicts with the individual's own perception of self. This process can be psychologically taxing but is bolstered by the motivation to solve the issue at hand. Woods-Wells (2016) posited that recognizing diversity among African American men and their individual contributions better facilitates social interactions and builds more inclusive environments. Based upon the experiences of participants in this study, social capital and relationship development are important motivational factors for degree completion. Introspection, interaction, and interpretation, as described in the conceptual model, inform the on-going process of self-analysis, the influence of group dynamics, and the creation of meaning associated with processes in the development of a STEM identity (product). This product is viewed through a critical race lens based upon societal norms and standards that are often grounded in practices of White supremacy. The historic and racialized experiences of African American men as a group, in conjunction with their unique experiences within the STEM environment, describe why this demographic has lower representation within STEM. The failure to acknowledge unconventional knowledge, culture, or experiences operationalizes concepts of colorblindness, demonstrating the need to further explore diversity related to thought, cognition, and the acceptance of diverse perspectives. The triadic reciprocal nature of the conceptual model provides information that offers a better understanding of the importance of the relationship between expressed identity and environment in eliciting pro-social and pro-STEM behaviors, highlighting the importance of creating environments that affirm both personal and cultural identities. The product of these interactions, persistence, is a result of the ways that students interpret responses to their identities within their environments, and accounts for the racialized perceptions often associated with their identities as African American and male.

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Appendix

Table 1. Interview Participant Demographics (N = 10)

Pseudonym	Traditional/ Non-Traditional	School Type	Major	KAI Sub Scores	Overall KAI Score
Malik	Non-Traditional	PWI	Statistics	SO: 38 E: 13 R: 25	76
Judah	Traditional	PWI	Psychology	SO: 45 E: 14 R: 34	93
Darius	Traditional	PWI	Engineering	SO: 45 E: 21 R: 33	98
Roy	Traditional	PWI	Engineering	SO: 40 E: 17 R: 44	101
Xavier	Traditional	PWI	Engineering	SO: 53 E: 24 R: 28	105
Antonio	Non-Traditional	HBCU	Agricultural Education	SO: 42 E: 22 R: 45	109
Khalil	Traditional	PWI	Information Technology	SO: 55 E: 20 R: 44	119
Shyheim	Traditional	PWI	Environmental Science	N/A	UI
Tyrik	Traditional	HBCU	Natural Resources and Environmental Design	N/A	UI
Omar	Traditional	PWI	Engineering	N/A	UI

Note: PWI = Predominantly White Institution; HBCU = Historically Black College or University; UI = uninterpretable score; overall Kirton's Adaption Innovation (KAI) score is the combined total of SO, E, and R scores