



## **WIP: Unpacking the Black Box: How does a Cultural Engineering Student Organization Support the Persistence of Students of Color?**

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# **WIP - Unpacking the black box: How does a cultural engineering student organization support persistence of students of color?**

## **Introduction**

Many initiatives in the U.S. are designed to increase participation of individuals from underrepresented ethnic minority (URM) groups in science, technology, engineering, and mathematics (STEM) fields. In engineering, despite an increase in the enrollment of and degrees awarded to individuals from Hispanic/Latinx populations, the trends for Black, Native American, and Native Hawaiian and other Pacific Islander populations have remained relatively stagnant. As a result, research and evaluation of interventions that support the recruitment and retention of URM students have increased. However, few studies have investigated how and why specific intervention types influence recruitment and retention. Nuances of student experiences at the intersection of race, ethnicity, and gender are also underexplored as few studies disaggregate URM populations. A deeper understanding of the “who” and the “why” can help us identify specific factors that result in the biggest impact for students and what to consider when implementing initiatives in different contexts and settings.

Cultural engineering student organizations such as the National Society of Black Engineers (NSBE) are a type of co-curricular initiative that provides support for students from traditionally underserved populations. Recent studies of local NSBE Chapters at predominantly white institutions (PWIs) show that Black engineering students who participate in such chapters achieve more equitable outcomes (e.g., graduation rates that meet or exceed the percentages of the total engineering cohort at their institution)[1], [2]. However, further investigation is needed to provide empirical insights into how and why these kinds of outcomes occur.

To study an engineering student organization focused on increasing the number of Black engineers, this work leverages and extends two theoretical frameworks: 1) the Model of Co-Curricular Support (MCCS) [3], [4] and 2) Community Cultural Wealth (CCW) [5]. This paper presents intermediate insights in the development of a preliminary codebook for the broader study. The potential interplay between these frameworks can help us rethink retention theories to account for the experiences of students of color framed from an institutional support and student empowerment perspective. Insights from this study can also inform the advising and operation of cultural engineering student organizations as key partners in efforts to broaden participation.

## **Theoretical Frameworks**

MCCS is an empirically-developed, practice-oriented student retention model that outlines how engineering student support centers (ESSCs) (e.g., Minority Engineering Programs) leverage programs, activities, and services to support underrepresented engineering students in attaining long-term objectives for student success such as degree progress, academic achievement, career attainment [3]. Extending Tinto’s model of institutional departure, MCCS similarly identifies student integration as a short-term outcome related to student success. However, MCCS re-conceptualizes student integration as “the qualifications and personal attributes (i.e., knowledge, skills, and abilities) needed to be a successful engineering student and is associated with having sufficient awareness and access to the resources necessary to be successful within a given

domain in the context of engineering education” [4, p. 2]. These domains include the academic, social, and professional subsystems of an engineering college as well as the broader university context. A students’ perception that they have the knowledge, skills, and abilities (KSAs) to be successful in these domains are categorized in four short-term outcome categories: *academic integration, social integration, professional integration, and university integration*. For example, professional integration refers to a students’ perception that they have KSAs to be successful within professional subsystems in engineering education. KSAs in the professional domain can include technical, leadership, and other professional skills that help a practicing engineer perform and succeed [4].

CCW refers to the “array of knowledge, skills, abilities and contacts possessed and utilized by communities of color to survive and resist macro and micro-forms of oppression” [5, p. 77]. Grounded in critical race theory, CCW is an asset-based framework that highlights six cultural resources—*aspirational, navigational, social, familial, linguistic, and resistant capital*—that communities of color draw on to succeed in educational environments not designed for them as shown in Table 1. CCW has recently been used to explore the persistence of students of color in engineering contexts [6]–[8].

Table 1. CCW elements as defined by Yosso [5, pp. 77–80]

Aspirational capital	“The ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers”
Navigational capital	“Skills of maneuvering through social institutions” that historically were not created for a particular community
Social capital	“Networks of people and community resources” and the knowledges and support provided by social contacts
Familial Capital	“Cultural knowledges nurtured among familia (kin) that carry a sense of community history, memory and cultural intuition...expands the concept of family to include a more broad understanding of kinship”
Linguistic capital	“Intellectual and social skills attained through communication experiences in more than one language and/or style”
Resistant capital	“Knowledges and skills fostered through oppositional behavior that challenges inequality”

## Methods

NSBE is an international, non-profit, student-led organization based in the U.S. Its mission is to “increase the number of culturally responsible Black engineers who excel academically, succeed professionally, and positively impact the community” [9]. With pre-college (NSBE Jr.), collegiate, and professional chapters, many members’ primary interaction with NSBE is through participation in a local chapter. Chapters further interact and engage through regional and national conferences, competitions, and other programs. As a student-led organization, collegiate (undergraduate or graduate student) members hold elected offices at the chapter, regional, and national levels of the organization.

NSBE chapters, with university and national organization support, design interventions to “increase the number” of Black engineers while promoting degree progress and academic and

career achievement for engineering students. As such, student integration as defined by MCCS is a desired outcome of chapter programs, activities, and services. As part of the Black community, NSBE chapters maintain a commitment to their cultural community. Furthermore, the chapter itself serves as a community that supports its members by developing and leveraging KSAs and contacts needed to persist in engineering. This study seeks to apply and extend MCCS and CCW in the context of one collegiate NSBE chapter at a large, Midwestern PWI. MCCS and CCW highlight key aspects of NSBE's operations and can provide empirical insights into how NSBE Chapters support their members and why positive associations such as increased graduation rates may occur.

This paper describes initial steps in the development of a preliminary codebook and preliminary insights from an analysis of three student interviews drawn from a larger qualitative case study. The larger single case study explores how participation in a local chapter of NSBE at a PWI provides co-curricular support for engineering students. Data collection and analysis are guided by the following overarching research question: *How does a cultural student organization provide co-curricular support for engineering students at a predominantly white institution?* Addressing this question in turns requires a focus on the following sub-questions:

1. How does the NSBE chapter influence engineering students academically, socially, and professionally?
2. In what ways does the NSBE chapter leverage and facilitate community cultural wealth in students?

The broader study includes interviews with current and former student members and other chapter stakeholders such as the chapter advisor and institutional representatives. The primary author conducted semi-structured interviews using ethnographic interviewing techniques [10], [11]. The three interviews selected for this preliminary analysis represented current students with different levels of involvement in the chapter and accounted for some of the diversity in demographic backgrounds in the wider data set. The primary author cleaned and de-identified interviews previously transcribed by a third-party service. They also wrote memos focused on their positionality during this initial review stage accounting for their Caribbean heritage, Black identity development, and experience as both a member and former leader in NSBE.

We used a simultaneous coding process [12] in order to code segments of the transcript multiple times. The lead author iteratively coded the interviews in three passes using both inductive and deductive approaches. The first pass was open-coded, keeping in mind the overarching research question, goals and intents of NSBE, interactions and overlap with parallel institutional efforts (e.g., Minority Engineering Program (MEP)), as well as climate and cultural context elements at different levels (e.g., institution, NSBE Chapter, higher education in general). The second pass, guided by the first research question, focused on the four integration categories of MCCS as *a priori* codes. Anything aligned with a member having "sufficient awareness and access to resources necessary to be successful" in engineering that did not directly fit into these definitions was coded as "Integration-Other" for future analysis. Also, an emergent code of "No Integration" noted situations where participants identified a lack of resources and support. Guided by the second research question, the third pass of coding was guided by *a priori* codes representing the six CCW capital elements and the emergent code "Capital-Other."

To ensure appropriate use of the two frameworks throughout the coding process, the primary author has regular discussions with researchers familiar with MCCS and CCW. These conversations also help to identify when data supports the extended definition of a framework concept or a new facet not accounted for in the frameworks. In addition, discussions with researchers who do not have an intimate knowledge of NSBE help to clarify coding categories.

### **Preliminary Observations**

The preliminary analysis suggests two main insights about the applicability and utility of the CCW and MCCS in the context of the present study. First, simultaneous coding of CCW and MCCS reveals a strong sense of interplay between the two frameworks. As shown by the quote presented below, the chapter provides opportunities for members to access navigational capital. The student learned academic success strategies (e.g., asking for help, working with peers) within the chapter community where the student was comfortable being vulnerable. In the broader social and academic system of the engineering college, the student faced negative racial stereotypes of academic inferiority. Navigational capital in the form of academic success strategies helped the student to be successful academically (i.e., academic integration)—especially in the first and second years of an engineering program. As the student explained:

*[NSBE helped me overcome the] challenge of passing my first year of classes! Definitely got me through that one because I had to get over that whole, "I don't want to ask for help." And everyone was struggling, and once I realized everyone's struggling, I mean we might as well try to struggle together, help each other get through versus you do this by yourself and drown miserably when they're at least helping you stay afloat. In my first year I learned, you really have to learn to lean on the people who are also going through the same experiences as you are.*  
– Black female, Senior [Navigational Capital (CCW); Academic Integration (MCCS)]

This highlights one potential connection between the two frameworks. CCW is positioned to counter macro and micro-forms of oppression faced by Black engineering students in an engineering education system designed for White males [6]. As highlighted by its mission, NSBE as an organization has similar aims. CCW allows us to represent a subset of culturally relevant KSAs that NSBE members leverage and develop through participation in the chapter to persist in engineering. As such, NSBE provides members access to and awareness of resources to successfully navigate academic systems of the engineering college as described in MCCS.

As a second point of insight, the extension of CCW into the context of a cultural engineering organization raises other important considerations. Within CCW, social capital describes networks of people and support received through relationships and community resources, and familial capital embraces a connection to the cultural community and highlights cultural knowledge learned through family-like relationships. Social capital is a known benefit of NSBE [13]. However, aspects of the NSBE community revealed in participant interviews suggests something beyond the CCW notion of social capital. Familial capital provides language for articulating this idea. For example, one participant in a description of what the NSBE mission means to him alludes to: 1) a connection to community well-being, 2) a family-like organizational structure across different age groups, and 3) how persons at different levels of the organization influence members' educational and occupational consciousness. This excerpt also

highlights how familial capital can foster aspirational capital to promote student persistence and integration into professional engineering systems (i.e., professional integration). As this interviewee elaborated:

*Positively impacting the community for me is like, you have to make sure that even if there's a student that doesn't want to be an engineer, like that's fine. If you're a black student and you don't want to be an engineer, that's fine, but I feel like it's still important for us to let people know that you can do this. Even though you don't necessarily want to, you can be an engineer. And that's kinda hard to do sometimes if you're just a college student. It's sometimes hard to show people if you're just a professional and it's hard to show people if you're just a high schooler. I feel like that combination of people ... you have to have people in varying age ranges and varying, um, positions within their career to let people know that they can be an engineer and they can be successful in whatever they do. – Black male, Junior [Code: Familial Capital (CCW); Aspirational Capital (CCW); Professional Integration (MCCS)]*

However, similarities between social and familial capital pose challenges with developing codebook definitions. Is it enough to code the use of familial language (e.g., studying with NSBE family) as familial capital, or is this a form of social capital enabling academic support? Is this an important distinction to make when considering interventions with communities of color? Further analysis will help refine these categories and understand the dynamic interactions between the various forms of capital that exist within a cultural student organization.

### **Next Steps**

Preliminary coding shows that CCW and MCCS have applicability in the context of a NSBE Chapter at a PWI and can help explain the role a chapter plays in the engineering journey of its members. Two more interviews will be coded towards the development of a preliminary codebook with continued attention to the development of emergent codes, interacting support systems (e.g., MEP), what needs remain unmet by chapter members, and other pertinent context elements. This codebook will be shared with other researchers both familiar and unfamiliar with the frameworks to ensure clarity and distinctness of the definitions and appropriateness of associated examples. We plan to share insights gained throughout this process and engage in continued discussions about potential findings and directions from further analysis within the broader study in presenting this paper. In addition, how authors engaged an intersectional approach to data collection and analysis will be included in future work.

This research aims to contribute to other scholarship that employs asset-based approaches to examine persistence by investigating interventions with successful outcomes, including to highlight avenues through which students can successfully navigate institutional and societal challenges faced on their journey to be an engineer [6], [8], [14]–[16]. It is also expected that results from this study can give contextualized voice to student-led efforts in retention [17].

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