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SENSE OF BELONGING OF BLACK STUDENTS IN STEM MAJORS: A MIXED METHODS STUDY

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SENSE OF BELONGING OF BLACK STUDENTS IN STEM MAJORS:

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Abstract

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A MIXED METHODS STUDY

By Lisa Jackson, Ph.D.

A dissertation submitted in partial fulfillment of the requirements for the degree Doctor of Philosophy in Education at Virginia Commonwealth University.

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The purpose of this research was to examine Black STEM students' sense of belonging, as it pertains to their academic and social integration. The researcher also sought to understand what factors most contributed to students' sense of belonging and whether the involvement in a living learning community or summer bridge program had an effect on students' sense of belonging. An explanatory sequential mixed methods design was used with participants from a large, urban university in the Mid-Atlantic United States. Participants ($N = 89$) were administered a revised Psychological Sense of School Membership survey, then participants ($N = 8$) were purposively selected to participate in one-on-one follow-up interviews. Quantitative data were used to run a principal component analysis, an independent t-test, and a multiple regression analysis. After the quantitative data were analyzed, the qualitative data were collected and analyzed. Finally, the results of both portions were combined and analyzed through mixed methods analysis.

Results of the principal component analysis identified a two-component model containing 15 of the original 20 items. The two-components were identified as 'interactions" and "welcoming/belonging." Additionally, survey results indicated that students in a cohort did not differ significantly based on their sense of belonging, as measured on the PSSM. Sense of belonging also was not a significant indicator of academic success. Seven themes emerged during the qualitative phase of the study, they were: (a) student perception of the university; (b) student perception of STEM; (c) individual attributes; (d) family; (e) faculty interaction and support; (f) peer interaction and support; and (g) recommendations. Results of these findings were surprising; students of differing groups shared very important details regarding their sense of belonging and the influences on campus that have impacted it. Together, the quantitative and qualitative data provided very deep and intricate details of students' perceptions of belongingness.

Many of the findings within this study confirmed that of previous research on belonging. Students highlighted the importance of relationships with others, specifically with faculty and peers, to their belonging and success in the university. Several students identified their peers as being the most important factor to their sense of belonging. This study provided researchers, university administrators, professors, and even students insight into the world of Black STEM students and highlighted the nuances associated with their attendance at a predominately White institution and studying in a White, male dominated field.

Chapter I: Introduction

Belonging to a group can influence human lives in positive ways. According to Asher and Weeks (2014), when the need to belong is satisfied, people generally feel a sense of increased well-being, motivation, and health - both mentally and physically. Findings from several recent studies have shown positive relationships between belongingness and student engagement (Strayhorn, 2008, 2015), self-efficacy (Zumbrunn, McKim, Buhs, & Hawley, 2014), satisfaction in the university (Strayhorn, 2008), persistence in college (Hausmann, Schofield, & Woods, 2007), and positive self-perceptions (Pittman & Richmond, 2008). Entering college is a major transition in the lives of young adults that includes assimilating and becoming integrated into the university environment (Pittman & Richmond, 2008). This transition is often difficult for students and can cause withdrawal, depression, and eventual dropout if students are not properly integrated early in their university and academic experiences. With the links between sense of belonging and academic and social outcomes, it is critical to examine how students' sense of belonging may be enhanced or hindered in educational settings.

In particular, Black students may struggle with assimilating to the culture of predominantly White institutions (PWI) (Maton, Hrabowski, & Schmitt, 2000); this difficultly is further escalated when accounting for academic major selection. Black students are typically the minority in science, technology, engineering, and math (STEM) fields (National Center for Education Statistics (NCES; U.S. Department of Education, 2015), which could further the feelings of isolation experienced on campus and within their majors (Seymour & Hewitt, 1997).

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Maton, Hrabowski, and Schmitt (2000) suggested that Black students struggle because they feel excluded from the core campus community. A strong sense of belonging may assist in the integration of Black students on college campuses, which may be useful for their retention and success (Strayhorn, 2015). The current study sought to understand how sense of belonging of Black students in STEM majors influenced academic achievement and inclusion while in college.

Statement of the Problem

Over the last two decades, a major focus of the nation has been to increase the number of students that enter and complete STEM degrees, and to have those students eventually enter STEM careers. In 2007, the National Academy of Science warned that the weaknesses within the United States' STEM education system could threaten the economy, prosperity, and power of the nation (National Academy of Science et al., 2007). In 2009, President Obama gave a resounding State of the Union where he discussed the need to regain leadership in the area of STEM by increasing the number of graduates that would be eligible for STEM careers. To ensure that the nation is in position of power and prosperity, a larger pool of applicants need to be prepared to go into these high-demand fields.

Universities struggle with recruitment and retention of students in STEM fields; this issue is even more pronounced with Black students (Seymour & Hewitt, 1997; Maton, Hrabowsik, & Schmitt, 2000). It is important for researchers to examine what factors may contribute to the decline in students entering and successfully completing STEM degrees. A decrease in graduation rates across all disciplines, and especially in the STEM fields, could lead to a decrease in potential employees in a growing market. According to researchers at the NCES (2014), Black students at 4-year public institutions graduate at a much lower rate than their non-

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Black peers. The 2007 entering class had an average of 33.5% of all students graduate after 4 years. Black students, however, experienced almost one half of that rate—17.4%; while Asian, White, and bi-/multi-race students experienced the highest graduation rates after 4 years— 39.8%, 36.9%, and 35.9%, respectively. As well, the amount of overall STEM degrees conferred to Black students in 2013 was far less than that of White students, 9.4% and 66.3%, respectively (U.S. Department of Education, 2015). These statistics suggest that there may be an issue with Black students who successfully complete degrees in STEM fields but there may also be an issue with Black students completing undergraduate work in general.

Although graduation rates of Black students have increased slightly over the years (U.S. Department of Education, 2014), other races have seen more drastic increases. From the 1996-starting cohort to the 2007-starting cohort, Black students have only experienced a 2.4% increase in 4-year graduation from public institutions. However, other races have improved their 4-year graduation at a much higher rate over the same period—White students experienced an increase of 8.6%; Hispanic student graduation rates increased 8.2%; and Asian students experienced an increase of 11.3% over the same 11-year period (U.S. Department of Education, 2014). University officials and researchers should not only continue to encourage increased graduation rates for all students but should also examine closely why Black students have been struggling for over a decade to increase their graduation rates. Recruiting these students is only half the battle, ensuring that they graduate is the other half. Low recruitment and retention rates position these students at a disadvantage early on in the job market. Lower matriculation and lower graduation rates may lead to lower representations in fields across the board but even more in the STEM field where the market is ever-growing.

Research in this area will not only increase knowledge in the academic and research community, but it could also assist university administrators in learning what may be causing the decrease in matriculation and graduation of Black students, especially in STEM fields. Policy-makers may also benefit from this work. The research may be able to provide stakeholders with information that can lead to informed decisions and solutions for increasing graduation rates in the areas of STEM. Students also stand to benefit from this research. By learning more about belongingness of Black STEM students, programming could be developed to encourage Black students' university integration and graduation. Finally, an increased sense of belonging would likely lead to a positive impact on students' academic performance and their overall college experience (Fass & Tubman, 2002).

In attempts to remedy retention issues, university programs have focused on factors related to family support and history, lack of academic preparation, and disadvantaged economic situations (Maton, Hrabowski, Schmitt, 2000). However, belongingness can also have an influence on students' continued commitment to higher education (Maton, Hrabowski, Schmitt, 2000). According to Deci & Ryan (2000), just as the other basic needs (i.e., food, water, and safety), the need to belong must be met for students to be successful; when unmet many of the same consequences may occur as when a student feels unsafe on campus. The lack of belonging has been associated with a number of negative consequences for students including withdrawal, poor mental and physical health, decreased motivation, impairment in development, and poor performance on assignments (Deci & Ryan, 2000; Strayhorn, 2015). A strong sense of belonging to a group or organization is often associated with positive outcomes, such as improved mental and physical health (Walton & Cohen, 2011; Stebleton, Soria, & Huesman, 2014). If the goal of higher education institutions is to retain students to promote the economy,

as well as to improve the lives of students, then more attention should be paid to the factors that have been known to increase students' staying power.

Have enough steps been taken to ensure universities are properly integrating Black students into the campus environment? Ensuring integration into the university can mean the difference between students who choose to persevere and those who decide to dropout (Strayhorn, 2008). Universities across the nation are promoting summer-bridge and summer enhancement programs to assist low income and typically marginalized students in STEM programs as a way to drive collaboration and integration in the university and programs (Maton, Hrabowski, & Schmitt, 2000; Maton & Hrabowski, 2004). To integrate students into the university, many universities have also implemented living-learning communities by placing students in living environments where there is a focus on a specific academic experience, such as a shared learning experience (Tinto, 2003). The success of these programs may help demonstrate the importance of promoting these experiences for students. The federal TRiO program is a long running program that has shown its effective in graduating typically marginalized groups at a much greater rate.

The federal TRiO (not an acronym) program was instituted in 1965 to ensure all students were given equal opportunities in education regardless of race or economic background. This is only one example of a program aimed to increase minority participation in higher education (Federal TRIO Programs, 2015). TRiO received its name because the original initiative consisted of three programs that were implemented in the earlier years of TRiO. The first program, Upward Bound, was established under the Educational Opportunity Act of 1964. In 1965, the Higher Education Act established the Talent Search and the Special Services for Disadvantages Students programs. The TRiO program has since expanded and now includes

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eight programs with the goal of addressing economic, social, and cultural barriers in higher

education. The programs and their descriptions can be found in Table 1. Research has shown

that when compared with students of similar backgrounds those who participated in TRiO were

more likely to complete college (Ostrove & Long, 2007).

Table 1

TRiO Programs and Descriptions

TRiO Program	Program Description
Educational Opportunity Centers	Targets low-income families and assists them with choosing the appropriate college and financial packages
Ronald E. McNair Post-Baccalaureate	Promotes low-income and minority students to pursue college teaching and to prepare them for doctoral work
Student Support Services	Assists low-income students while they pursue their bachelors degree by providing counseling, remedial instruction, and tutoring
Talent Search	Serves students in grades 6 -12 and prepares them for the application process, scholarships, and admission requirements of college
Training Program for Federal TRiO Programs	A grant program intended to enhance faculty and staff employed at TRiO sites
Upward Bound	Prepares students for higher education by exposing them to courses that are important for the first year of college over weekends and during the summer
Upward Bound Math-Science	Helps low-income students increase their knowledge and skills in math and science
Veterans Upward Bound	Provides tutoring, instruction, and college guidance for veterans transitioning into higher education

Universities have also begun to implement similar programs that seek to encourage

inclusion and sense of belonging in the university. The Louis Stokes Alliance for Minority

Participation (LSAMP) is a multi-site program that seeks to increase student participation in

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STEM majors and to diversify these fields of study (NSF-LSAMP). The programs intend to bring students closer socially and academically, while exposing them to the possibilities in STEM prior to starting their freshman year. Additional support is continued throughout the program to ensure the success of these students. Another goal of the program is to foster positive relationships between students, faculty, staff, and alumnus in the STEM fields, a central tenet of belongingness. Programs such as TRiO and LSAMP seek to increase the involvement of students both in the university and in specific areas of study. Research has provided evidence to suggest that sense of belonging can be facilitated by positive involvement and interactions. Strayhorn (2012) noted that involvement in college increases sense of belonging by:

"(1) connecting students with others who share their interests, values, and commitments; (2) familiarizing students with the campus environment and ecology; (3) affirming students' identity, interests, and values as 'a part of campus'; and (4) generating feelings among students that they matter and others depend on them (p. 115)."

The programs described earlier strive to meet the same aspects that Strayhorn outlined in his text and have demonstrated their success and accomplishments with students. Programs that target students before they are engrossed in their new campus life often seek to accomplish this level of involvement prior to students attending the institution. Facilitating students' involvement and sense of belonging early on could aid students in becoming more committed to the university, being more willing to participate, being more motivated, and deciding to persist until successful completion (Osterman, 2000). Universities have the power to help ensure students' needs are met, whether through early programming and/or ongoing mentorship.

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Purpose of Study

The purpose of the current study was to examine Black STEM students' sense of belonging and to determine whether belongingness played a role in students' academic achievement. An explanatory sequential mixed methods design was employed, which involved collecting quantitative data first and then explaining the quantitative results with the use of in-depth qualitative data. In the first phase of the study, an adapted version of the Psychological Sense of School Membership (PSSM) was used to collect data from Black college students who had declared STEM majors. The data were collected from a large, urban university in the Mid-Atlantic region of the United States. The quantitative data was used to address the relationship between sense of belonging of Black STEM students who had participated in a cohort program and those who had not, and will also examine whether age, gender, major, and scores on the Psychological Sense of School Membership (PSSM) scale can predict student self-reported grade point average (GPA). In the second phase, qualitative data were collected to help explain the results obtained through the quantitative phase. In this follow-up phase, in-depth semi-structured interviews were conducted to explore aspects of belongingness with eight students, which represented different combinations of PSSM score levels and participation in cohort programs.

Measuring student sense of belonging can help university administrators and institutional policy-makers evaluate and review programs and classes intended to assist student retention and success. A number of learning communities, summer-bridge programs, and freshman classes exist that target the retention of students in college, though additional information is needed to assess the effectiveness of such initiatives. The current study examined how these types of programs assist in increasing students' sense of belonging. Without effective programming and interventions to solve issues of recruitment and retention, Black students may continue to

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graduate at a lower rate than their peers. Although the literature shows the impact of sense of belonging on general college student academic outcomes; more information is needed to determine how sense of belonging influences academic achievement and how other factors, such as high school GPA, age, gender, and major relate to sense of belonging.

Research Questions

The current study was guided by the following questions:

R1: Quantitative: Is there a significant difference in sense of belonging between Black STEM students who participate in cohort-supported programs and those who do not participate in these programs?

R2: Quantitative: Is student self-reported GPA associated with age, gender, major, and scores on the adapted Psychological Sense of School Membership scale?

R3: Qualitative: How do Black students describe their perceptions of belongingness at the university and in their STEM programs?

R4: Qualitative: In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program?

R5: Mixed Methods: How do the experiences of Black STEM students support or contradict the results of students' perceived sense of belonging scale scores?

Definition of Terms

Sense of belonging will be used throughout this paper and will be important for understanding the nature of this study. To briefly introduce readers to this term, a brief definition has been included. Several other terms that will be used throughout the paper have also been provided.

Sense of Belonging. Belongingness has been found to have positive effects on group and individual motivation (Goodenow, 1993a; Baumeister & Leary, 1995; Pittman & Richmond, 2008). Sense of belonging or belongingness is associated with the relatedness of an individual to a community, a group, or an organization (Baumeister & Leary, 1995). Prior to Baumeister and Leary's seminal piece on belongingness, several researchers examined sense of belonging in the context of mental health, and in psychological and psychiatric studies (Hoffman, Richmond, Morrow, & Salomone, 2002). Hagerty, Lynch-Sauer, Patusky, Bouwsema, and Collier (1992) defined sense of belonging in the context of nursing as the experience of involvement to an organization or environment that makes the individual feel like an important part of that environment. A sense of belonging, in the context of higher education, refers to the connection that an individual feel to their university, their peers, and their professors. Having a sense of belonging is a basic human need that is almost as important as food and essential for daily functioning (Baumeister & Leary, 1995; Stillman & Baumeister, 2009). Belongingness is characterized by positive and frequent social interaction. The need to belong is not met by simply being around other individuals, and the need is not met if those connections are unsupportive or negative in nature. Individuals must have frequent, supportive, and nurturing relationships for the need to be met. An increased sense of belonging has been, especially in schools, a predictor of adjustment, academic achievement, and lower attrition rates (Hoffman, Richmond, Morrow, Salomone, 2003; Pittman & Richmond, 2008).

Cohort programs. Cohort models have often been utilized in doctoral programs; however, more undergraduate programs have been relying on them. A cohort model or program is defined as a group of students that are purposefully placed together based on some type of shared experience, such as future goals, career aspirations, or cultural background (Maher,

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2005). These programs range from communities in which students live in the same dorm hall to programs that are summer preparatory (summer bridge) programs.

STEM. STEM has been traditionally defined as the fields of science, technology, engineering, and math. The term came to prominence in the mid- to late-2000s when policy makers and educators were warned of the decline in achievement of children in the United States in these areas (Gonzalez & Kuenzi, 2012). On the surface, the term is easy to define, however, in its intricacies lays a larger definition. Many different agencies and universities define it in many different ways. For this study, the researcher attempts to narrow that definition to a more manageable one. STEM will include students within Biological Sciences, Computer and Information Sciences, Engineering, Mathematics, and Physical Sciences.

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Chapter II: Literature Review

Method of Review

The review of literature relied primarily on electronic data searches. Prior to using electronic databases, the researcher relied on literature that was acquired through coursework, which lead to additional sources of literature that pertained to the current study.

Google Scholar, JSTOR, and EBSCOhost were the primary databases in the search for literature. Utilizing the functions of EBSCOhost, the researcher searched several smaller databases such as Academic Search Complete and Education Research Complete to gather more options for review. Many of the searches were not limited to a time range because of variety of seminal pieces in this field of study. *Sense of belonging* and *belongingness* were used as initial search terms. To further narrow the search, additional terms were used in the electronic searches. The terms *scale, students, minority students, black students, survey,* and *STEM* were used to accompany the original search terms.

All sources were reviewed for several characteristics prior to inclusion in the literature review. Inclusion was determined using several factors, which included year of publication, relevancy to current literature base and to the current study, sample size for quantitative studies, and psychometric properties for sources on instrumentation. Dated literature pivotal to this study, but not available electronically, were located through library searches.

Theoretical Framework

In the following section, the theoretical frameworks that guided the current study will be reviewed. The first to be discussed is Tinto's Model of Institutional Departure (1975, 1993) that has been used by researchers for many years. This model introduces student dropout through the lens of Durkheim's theory of suicide. The next model to be reviewed is Strayhorn's Model of Student Dropout, he utilized models from several theorists, including Tinto's, to create a model that more specifically examined at belongingness of college students and its relation to dropout. These models, taken together, were the infrastructure of the current study.

Tinto's Model of Institutional Departure. The current study was grounded in the theoretical framework of Vincent Tinto and his work on student dropout in higher education. In his seminal piece on student dropout in higher education, Tinto (1975) utilized several models to explain and form his theory of student dropout from post-secondary institutions. Relying on Durkheim's theory of suicide, Tinto conceded that the reasons for student dropout were likely similar to the reasons for suicide. According to Durkheim (1951), individuals commit suicide when they feel as though they are not integrated into society. Similarly, Tinto believed student dropout in higher education was analogous to suicide in society, such that divergence from mainstream college culture and the lack of peer relationships lead to malintegration into the college environment, which results in lack of commitment to the college or pursuit of degree attainment and eventual dropout.

College student dropout. Though integration into the academic and social domains of an institution has been considered important for retention of students in general, other factors should be considered. Past experiences, gender, race, and family structure are individual attributes that

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were taken into account when considering potential for dropout (Tinto, 1975). Figure 1 displays a model of the potential interplay of the factors of student dropout (Tinto, 1975).
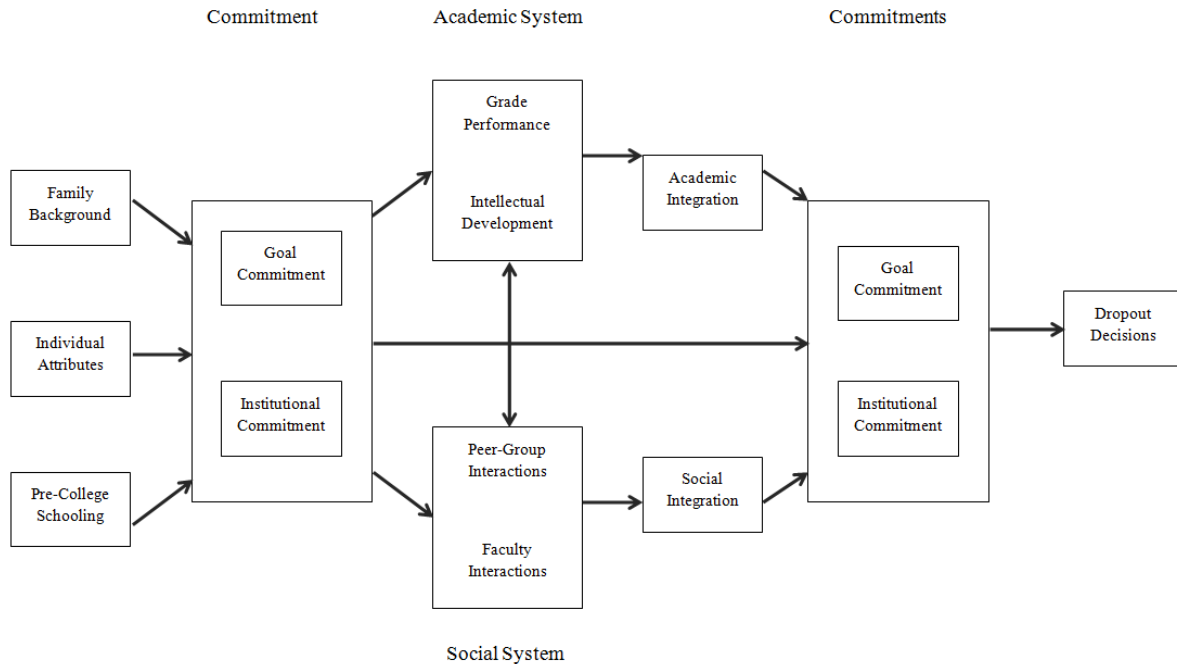
Figure 1. Tinto's Model of Institutional Departure (1975).

Individual attributes are only a small portion of Tinto's model of student dropout; commitment based on expectations and motivation are also important aspects. Commitments based on expectations refer to educational goal commitment. Educational goal commitment refers to student commitment to the university and their persistence to complete their degrees. For example, a student with high educational goal commitment may aim to obtain a doctoral degree. This student will likely be more committed to staying at the university and reaching their educational goals when compared to a student whose goal is to complete a bachelor's degree only. Tinto explains that these future thinking students have a more long-term view of their goals and accomplishments, which often means they will likely persevere through difficult times more than students who have shorter-term goals.

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Institutional commitment is also essential to retention in Tinto's model, as commitment to an institution may lead students to be more committed to persist through their program (Tinto, 1975). An example of this is if a student attended their parents' alma mater, then their legacy at this university may be enough for them to want stay and finish. Attending an institution for specific reasons may have influence on a student's persistence through school (Tinto, 1993). Lower goal commitment and lower institutional commitment is seen as a recipe for dropout. Other factors incorporated into Tinto's model include academic and social integration. Tinto (1975, 1993) argued that students' educational and institutional commitment is shaped by interactions between the student and their experiences in the academic and social systems at the institution. Tinto (1975) believed that academic and social integration were directly associated with student retention.

According to Tinto (1993), the degree to which a student feels academically and socially integrated can greatly influence students' decisions to persist through college. Students who experience positive and frequent social interactions and are involved in academically purposeful activities and programs are more likely to successfully complete college. For instance, students can be socially integrated into the college environment; however, the lack of the necessary academic integration in the classroom could lead to dropout due to bad grades (Tinto, 1993). Similarly, students who are adequately integrated into the academic aspects of college may be inadequately integrated socially, potentially leading to dropout due to lack of social congruence and personal relationships (Tinto, 1975). As he noted, "…excessive emphasis on integration in one domain would, at some point, detract from one's integration into the other domain" (p. 92). The relationship between the academic and social domains is reciprocal, though each domain is important in its own right.

Academic Integration. Academic integration refers to the level of individual integration that is usually measured in terms of achievement or academic grades and intellectual development in the university. These two aspects of academic integration are similar in ways but target different aspects of belongingness. Academic achievement, or grades, was explained by Tinto (1975) as a student being able to meet the standards set out by the academic systems, while intellectual development refers to the students' identification with the norms set out by the university. Tinto noted the importance of grades in students' desire to persist through college, however, intellectual development plays an even larger part in determining whether the student will feel integrated into the academic system. The appreciation of knowledge, of their academic career, and of gaining information is integral to those who persist through college. This appreciation of the academic system, as stated earlier, leads to an increase in integration into the university.

College student dropout has also been associated with race (Tinto, 1993). He noted that students of color, particularly those coming from disadvantaged backgrounds, often have issues with meeting the needs associated with attaining a degree. Students of color may struggle with the academic demands and expectations of college, and the work that goes along with it. They may also experience problems with finding their niche in the intellectual and social community of the institution (Tinto, 1993). Tinto explained that marginalized students, whether they belong to a racial minority or are from a disadvantaged background, often struggle integrating into schools' academic environment. Tinto believed that meeting the demands of the university was only part of the student retention issue. He also believed that part of the issue was the lack of students' academic self-concept, lack of self-appraisal, and their inability to properly assimilate to the university environment. The lack of proper preparation prior to the start of college can be

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detrimental to academic integration once students arrive at post-secondary institutions. It is important for parents, professors, academic advisors, school counselors, and others invested in education to consider how to effectively prepare and integrate students into the academic community upon arrival to the university, as academic integration is a critical factor for institutional commitment and eventual academic persistence.

　　　　Social Integration.　Social integration was defined as the level of integration of student experiences, which is determined by the level of congruency of the student's social life with one's own desires and expectations of the environment. Students' social integration into the university is reliant upon several factors. As illustrated in Figure 1, there is a social system that plays into student commitment to the university, which is believed to have some influence on students' decisions to dropout. Social integration is generally accomplished when university events, relationships, associations, or activities are congruent with students' expectations. Students of color, and particularly Black students, may find it hard to assume membership in a supportive community at the university (Tinto, 1993). Social integration into the university is more than just having a positive interaction with someone on campus; it's more about having faculty, staff, and students who share similar characteristics (i.e., race, religious background, cultural background) available for students to form a like-minded community. Predominantly White institutions often do not have faculty and/or staff who are representative of Black student background. For example, at a university that has been considered racially diverse, there are zero Black counselors at the university counseling center and only 5% of their tenure-track faculty members are Black (Llovio, 2015), while Black students make up about 15% of the student population (LUU at a Glance). An environment such as this may not be able to provide a place that feels welcoming or inclusive. Successful peer relationships, faculty relationships, and

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extracurricular activities may lead to greater social integration in the university (Strayhorn, 2012). Further, successful congruence in the social system of the university will likely lead to a commitment to peers, faculty, goals, and eventually to the university, which often leads to the desire to persist and the avoidance of dropout (Hausmann, Schofield, & Woods, 2007). There are parallels between sense of belonging and social integration. Sense of belonging is viewed as a precursor to social integration (Hurtado & Carter, 1997).

Summary. Tinto did not specifically include belongingness in his model on student dropout, however, a number of researchers have relied on his model of integration to explain belongingness (Hurtado & Carter, 1997; Hoffman, Richmond, Morrow, & Salomone, 2002; Freeman, Anderman, & Jensen, 2007). Belongingness is associated with a sense of community, which includes the sense of relatedness and integration (McMillan & Chavis, 1986). This description has many parallels to Tinto's notions of academic and social integration. Not unlike institutional commitment and integration, if students' need for belonging are unmet, then there is the potential for dropout. Higher levels of academic and social integration will more likely result in persistence and perseverance in school (O'Keeffe, 2013).

Sense of Belonging

Belongingness has been studied in great depth with students on many levels and has been associated with several positive student outcomes (Faircloth & Hamm, 2005; Hoffman, Richmond, Morrow, & Salomone, 2002; Stebleton, Soria, & Huesman, 2014). Baumeister and Leary (1995), in their seminal piece on the need to belong, provided information about aspects of life that have been influenced by having a sense of belonging, which included cognitive abilities, emotionality, behaviors, and overall well-being and health. They highlighted, as noted by other researchers, how important this concept was to human survival and indicated that a sense of

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belonging was "almost as compelling a need as food…" (p. 498). Baumeister and Leary (1995) posited that the need to belong is associated with frequent, positive, and meaningful interactions with other humans.

A strong sense of belonging is associated with positive outcomes, as explained earlier, while a lack of belonging can result in negative outcomes. Baumeister and Leary (1995) explained that individuals that lack supportive relationships would likely experience more stress than those who have close supportive relationships. The stress is the result of the lack of supportive figures to assist and advise during times of trouble. A supportive network, whether a parent, teacher, or peer, can help reduce stress by providing support and guidance. Similarly, people who are excluded from groups or lack a supportive network may experience more anxiety than those who experience inclusion. In extreme cases, the lack of inclusion can lead to tremendous stress and anxiety, which could further lead to depression in the individual (Baumeister and Leary, 1995). Baumeister and Leary (1995, p. 506) cited a quote by Karen Horney (1945) that described anxiety as the feeling of "being isolated and helpless in a potentially hostile world" (p. 41). Baumeister and Leary believed that social exclusion was one of the most common factors of anxiety and further supported Horney's notion that anxiety is caused by isolation and exclusion from a supportive network in a possibly harmful environment.

As mentioned earlier, interaction is often not enough to influence positive effects; interactions need to be frequent and positive. Baumeister and Leary (2005) explained that belonging to a group that is characterized by negative experiences, negative interactions, and nonsupportive or indifferent members is not enough to meet the need to belong. They also described that relationships characterized by positive interactions, yet experienced infrequently,

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are generally not enough to fulfill students' belonging needs. In sum, humans need consistent and positive interactions with members of their group for this need to be met.

   Student belonging in university settings. Pittman and Richmond (2008) and Fass and Tubman (2002) confirmed Baumeister and Leary's theory of belongingness. Pittman and Richmond (2008) posited that having a sense of belonging to the university during the onset of freshman year could contribute to positive adjustment for students. The researchers collected information regarding students' sense of belonging to the university, friendship quality, and several adjustment variables. They found that those who had increased university sense of belonging also displayed an increase in academic ability or what the researchers referred to as scholastic competence and social acceptance (Pittman & Richmond, 2008) and global self-worth (Gummadam, Pittman, & Ioffe, 2016). The students in this study also experienced decreased anxiety and depression. Sense of belonging and affiliation was not only linked to adjustment in students' first year of schooling, but was also associated with lower attrition rates and higher academic motivation over students' academic careers (Pittman & Richmond, 2008). Gummadam, Pittman and Ioffe (2016) found similar results when conducting a study with ethnic minorities. The goal of the study was slightly different in that they wanted to see how sense of belonging and ethnic identity, individually and collectively, influenced psychological adjustment in ethnic minority college students. Their findings showed associations between sense of belonging and psychological adjustments of students. They also found that when sense of belonging was lacking, ethnic identity was more strongly associated with psychological adjustment. These findings suggest that a strong belonging to one's ethnic group may protect minority students when their university sense of belonging is absent.

An attachment to at least one group is important for the success of students. Fass and Tubman (2002) found that the quality of the relationships and interactions of students were a key aspect to adjustment at the university. In their study, they sought to understand how attachment to parents and peers was related to factors including social functioning and academic achievement. The researchers found that varying degrees of attachment resulted in differing levels of academic functioning, self-esteem, and university attachment. Students who were found to have a typology of high parent and high peer attachment were found to be better functioning than any other typology. Their study supported Tinto's model for student dropout and Baumeister and Leary's theory of belongingness, the study demonstrated how important relationships and interactions are to the success and persistence of students in the academic environment.

Osterman (2000) further noted the need to belong was met when students felt a connection to university, professors, and more so when there was an attachment to peers. Osterman's theoretical piece on sense of community and belongingness in the university supports the need to better understand student needs at the university-level. Teacher support, instruction, and peer relationships contribute to students' sense of community and belongingness (Freeman, Anderman, & Jensen, 2007). The experience of community and belongingness in schools has been identified as having links to "1) the development of basic psychological process important to student success, 2) academic attitudes and motives, 3) social and personal attitudes, 4) engagement and participation, and 5) academic achievement" (Osterman, 2000, p. 327). Although university administrators may recognize the impact that student belonging beliefs have on academic achievement, Osterman suggested that more should to be done to facilitate students' sense of belonging. She pointed out that schools might be preventing students from building a

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healthy sense of community and belonging, and noted that the pervasive nature of bullying and isolation of peers could be impeding students' sense of belonging. Students who feel even slightly isolated may have a difficult time feeling important and supported in their school environments. Identifying how students' sense of community and belongingness can be facilitated on campuses may be a step toward understanding why students experience depression, dropout, and other maladaptive behaviors.

Strayhorn's Theory of Sense of Belonging. A new model of sense of belonging, that incorporates the work of Baumeister and Leary, Tinto, Maslow, and other researchers in the field, was recently introduced (Strayhorn, 2012) that was intended to be better suited for students of color. Although he recognized the importance of Tinto's model, Strayhorn noted that Tinto's model was often criticized for its limited applicability to students of color.

Strayhorn (2012) constructed a visually simpler version of Tinto's model, which also includes aspects of Maslow's Hierarchy of Needs (1954). Maslow's theory on human needs has been frequently referenced in belongingness literature because of the inclusion of belonging in the hierarchy of human needs (Baumeister & Leary, 1995; Goodenow & Grady, 1993). Human needs are organized into a triangle that is structured as a hierarchy with the most basic needs at the bottom of the triangle and the more complex needs at the top of the triangle. The hierarchy includes, from most basic to more complex: (a) biological and physiological needs, such as food and water; (b) safety, i.e. protection from danger; (c) love and belongingness, such as friendship and intimacy; (d) esteem needs, i.e. achievement; and (d) self-actualization, i.e. personal growth and fulfillment (Maslow, 1954). Each need must be met before individuals can proceed to the next need. If one need is not met, one will be motivated to satisfy that need first. In Strayhorn's

theory of sense of belonging, he takes into consideration the human needs and translates them to how they work with college students. He then emphasizes the needs to focus on belongingness.

Strayhorn's model is structured similarly to Maslow's traditional model of human needs. The new model can be found in Figure 2. Once each need is satisfied, humans, or more specifically students, in this case, are able to progress further up the triangle. Even in college settings, students must feel as though these needs are satisfied. If one element of the hierarchy is not met, students will focus more intently on having that need met. The example given by Strayhorn is when humans are lacking nutrients from food; they will develop an appetite for this element and will focus on feeding their bodies. Similarly, when students do not feel as though they belong, or if they are not accepted, they will focus on satisfying this need before being concerned with any of the more complex needs in the triangle, such as esteem or self-actualization. When students' need to belong is not met they will be motivated to satisfy this need, students will seek involvement and interactions to meet this need; if unmet there is potential for emotional withdrawal or even dropout from school (Strayhorn, 2012). The lack of social integration or belonging can either lead to persistent and commitment through the university (Tinto's model) or involvement, happiness, and achievement (Strayhorn's model). The lack of belonging may lead to dropout decisions (Tinto's model) or depression and suicide (Strayhorn's model). This emphasis shows us that belonging is not simply a want, but it is a need that may have dire consequences if not met. When explaining this aspect of the model Strayhorn (2012) cited Hausmann, Schofield and Woods (2007), which analyzed and explained persistence in college through academic and social integration. Their findings support Strayhorn's model in that students who had a strong sense of belonging and commitment to the institution were also more likely to have intention to persist.

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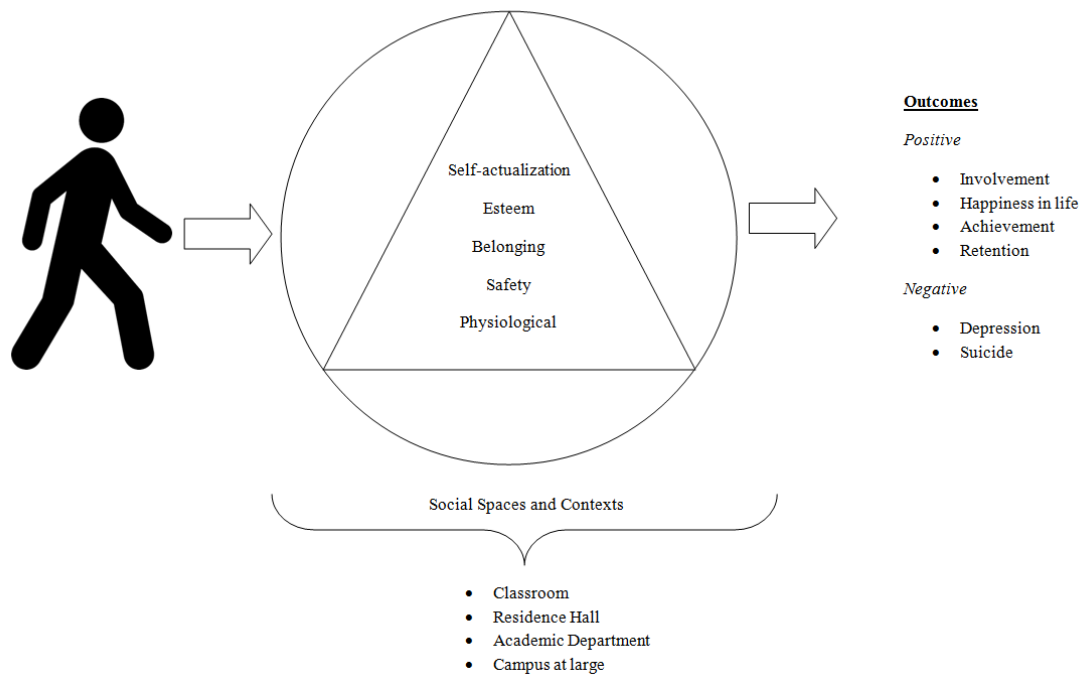
Figure 2. Strayhorn's model of college students' sense of belonging (2012).

Strayhorn (2012) recognized in his model that sense of belonging is a basic human need. A sense of belonging is not only important for students but also for humans in everyday life. However, sense of belonging may actually be even more necessary for groups of students that have been traditionally marginalized, such as students of color, women, and lesbian or gay students. The new model included several important characteristics of belongingness, they were:

1. Sense of belonging is a basic human need.

2. Sense of belonging is a fundamental motive, sufficient to drive human behavior.

3. Sense of belonging takes on heightened importance (a) in certain contexts, (b) at certain times, or (c) among certain populations.

4. Sense of belonging is related to, and seemingly a consequence of, mattering.

5. Social identities intersect and affect college students' sense of belonging.

6. Sense of belonging engenders other positive outcomes.

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7. Sense of belonging must be satisfied on a continual basis and likely changes as circumstances, conditions, and contexts change.

The first element, simply put, states that belongingness is a basic need, not unlike food and safety. As stated by Strayhorn (2012), "if sense of belonging is a basic human need, then it also is a basic need for college students" (p. 18). The second tenet in his model described sense of belonging as a motive, or something that forces or causes someone to act in a certain way. Strayhorn suggested that the need to belong could work in ways that could sway a person to join a particular organization, to go to a specific university, or to commit a crime. Students' need to fit in or to belong in their own niche has the power to drive them in many directions. As stated for the first element, students are affected by the need to belong, which has influence on their motives, behaviors, and choices (Strayhorn, 2012). The lack of belonging or the inability to find the right niche can lead students to dropout of school or transfer to another school where they may feel more included.

Strayhorn (2012) discussed how the need to belong does not always stay the same throughout life but instead can change depending on the context, the time period in life, and may also differ for different groups of people. He explained that sense of belonging was context- and person-specific. The need to belong can differ from place to place; a students' belonging may be very different at home than it is on campus. Sense of belonging can also vary depending on the time in a person's life, with adolescence and emerging adulthood being one of the most important times of transition. During this stage, young adults are trying to decide who they are and who they desire to be, what activities they should invest the most time, and with whom they want to associate with (Goodenow, 1993b; Strayhorn, 2015). Strayhorn also believed that certain populations, such as marginalized groups, may strive for the need to belong more than

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other populations. In the fourth element, Strayhorn explains to have the need to belong met, a person must not only have a few positive interactions but must feel like they matter to the group or university. College students often want to feel as if they matter on campus (Strayhorn, 2012). The fifth tenet of Strayhorn's model describes the intersection of identities, which refers to the interconnectedness of social identities and their influence on sense of belonging. For example, a student may identify as a Black honor's college student, his/her identity as a Black student may interact with his/her identity as an honor's student, which may influence one's sense of belonging. Student sense of belonging may be different if these identities did not converge.

According to the sixth element of Strayhorn's (2012) model, sense of belonging can positively influence other outcomes including well-being and happiness (Walton & Cohen, 2011), and achievement (Walton & Cohen, 2007, 2011; Zumbrunn et al., 2014). The seventh and final element of the model emphasizes the need for continual interaction, inclusion, and belonging. Disruption in a stable relationship, or in one's need to belong, can have negative consequences. This deprivation is enough to cause loneliness and depression, and for college students, disengagement or even attrition from college. To regain a sense of belonging, students will seek to remedy the problem by searching for new interactions and acceptance in their environment.

Relationship Between Tinto's and Strayhorn's Models

In this section, the researcher of the current study wanted to clarify why there were two theoretical models being used to guide the current study. Strayhorn's model may seem like the most appropriate and applicable theory to the study at hand, however, before delving into the model of sense of belonging, Tinto's model of student departure needed to be discussed.

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Strayhorn created his model with Tinto in mind, and as can be seen, there are many parallels, though depicted differently.

In Strayhorn's model, academic and social experiences are taken into account in the "Social Spaces and Contexts" portion of the model, which includes a magnitude of inputs that influence students' experiences. As explained in Strayhorn's book, if the model could be illustrated in 3-Dimension, it would include several circles that highlight several experiences that students encounter throughout their time in the university, in a number of different contexts. Taking this into account, Strayhorn found it important to use the informal and formal academic experiences explained in Tinto's model to explain his idea of interaction in the university that could potentially lead to a student's decision to stay in or leave college (Strayhorn, 2012).

There are aspects of each model that are lacking that is provided by the other, and for this reason, the researcher thought it was important to include both. Tinto's model appears to be more inclusive of a variety of inputs that students may experience when entering college, aspects that Strayhorn does not explicitly include. The researcher admired the consideration of socio-cultural input and family background in the Tinto model, however, this model does not go without criticism (Braxton, Sullivan, & Johnson, 1997). Tinto's model has undergone criticism regarding the lack of consideration of non-traditional and generally marginalized students. Some scholars believe that Tinto does not take into account other aspects that may be influencing these students to dropout. There are likely other factors that play a part in students' dropout decisions, however, due to the scope of this study and the researchers' interests, sense of belonging was targeted and included. The combination of the two models will hopefully suffice to explain the factors that influence student dropout but also to take in account a specific factor that is

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important for these students. The use of both Tinto's and Strayhorn's model was critical for the current study.

Sense of Belonging in Context

The following sections provide empirical evidence directly related to the current study. Although the current study did not specifically focus on Black males, the first subsection was included because it highlights several studies that examine factors related to the success of Black male students in higher education. The studies included in this subsection discussed support systems (Strayhorn, 2008) and integration of Black males (Hamilton, 2005; Reid, 2013), which have been connected to sense of belonging of students.

The second subsection focuses on Black students in STEM. This section was included because the researcher of the current study sought to explain why it is important to study students in the context of STEM majors. Several of the studies identified inclusion and integration as being essential for the success of Black students in STEM (Maton, Hrabowski, & Schmitt, 2000; Palmer, Maramba, & Dancy, 2011).

The third subsection included is evidence to support the need for the current study. This section will specifically look at sense of belonging of college students and its influence on motivation and academic achievement.

The final section reviews the single study that was found when searching for Black students' sense of belonging in STEM. The study reviewed specifically examines Black males in STEM majors and the influence of sense of belonging on GPA and a number of other variables. The lack of literature in this area further provides evidence that the current study is necessary to fill a gap on sense of belonging of Black students in STEM programs.

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Black males in higher education. Strayhorn (2008) does not specifically look at sense of belonging in this study, instead he focuses on support networks. However, support networks have the ability to enhance sense of belonging (Hurtado & Carter, 1997). Strayhorn (2008) conducted a survey study with 231 Black men to understand the relation between academic achievement and students' on-campus supportive relationships. Findings showed that strong support systems in college were positively related to satisfaction in college among Black men. Though this study specifically targeted Black males, Strayhorn concluded that an increase in support systems may facilitate student satisfaction and academic achievement, and it is necessary for universities to assist in providing students with these opportunities. Strayhorn suggested that these relationships may be developed through summer bridge programs or the federal TRIO programs because of their reputation to facilitate meaningful relationships among students and encourage academic success for students from typically disadvantaged and marginalized populations (Balz & Esten, 1998). The current study extended this literature by broadening the population of interest. Additionally, the current study examined the programs that are intended to promote healthy peer and faculty relationship, as mentioned in Strayhorn's study.

Aside from the involvement in programs that are targeted toward integrating students into the university, there is research to show there may be other factors that moderate belongingness of Black male students in higher education. Reid (2013) conducted a quantitative study to examine whether Black males with high GPAs at predominantly White institutions (PWIs) felt higher sense of institutional integration. The researcher of this study extended Tinto's model to include self-efficacy and racial identity. Data were collected from 94 Black males from five research universities. Findings from this study showed that academic and social integration was directly related to achievement, which further supports Tinto's theory. Using data from this

study, Reid (2013) proposed a new model that includes academic self-efficacy and racial identity as moderators of achievement through academic and social integration. That is, the most efficacious students also felt the most academically integrated into the university, and were subsequently more successful. Students with higher GPA scores also reported higher levels of social integration. The current study continued to examine integration of students in the university and how it may influence achievement, and extended the study from Black males to both Black males and females.

It was understood from the previous studies that there was a connection between support systems and persistence. However, Hamilton (2005) using qualitative methodology examined the specifics of why Black males were able to persist to degree completion. Five themes emerged during this study; three of the themes are reflected in Tinto's and Strayhorn's model of student drop out, they were: positive self-concept, realistic self-appraisal, and availability of a strong support system. These themes were associated with participants' experiences in school, particularly with persistence of Black men to degree completion. According to Tinto (1975), the lack of self-concept, self-appraisal, and a support network were the cause for student dropout. Hamilton's study provides further evidence that these variables can lead to positive outcomes and avoidance of dropout. Participants in this study noted the importance of having individuals that were culturally similar at the university that could provide support. This study is important for the current study because it further supports the importance of integration, support systems, and inclusion for success. The current study extended Hamilton's work by further exploring how inclusion and integration has assisted students in their persistence through and success in college.

Summary. In sum, a strong support system was a common theme across all three studies reviewed in this subsection. Strong support systems in college were related to satisfaction in college (Strayhorn, 2008), achievement (Reid, 2013), and persistence (Hamilton, 2005). A strong self-concept and an accurate self-appraisal were aspects of collegiate experience that were also strongly related to the persistence of Black male college students' persistence to degree completion (Hamilton, 2005).

Black students in STEM. The following studies focus on Black students in STEM programs and the factors that influence their success. The first study examines the perceptions of Black male student success and the second study specifically looks at a program that was created to ensure successful completion of Black students in STEM programs.

Palmer, Maramba and Dancy (2011) conducted a qualitative study to understand the academic and social experiences of Black students in STEM majors at a research intensive PWI. The researcher interviewed participants and focused on students' perceptions of what contributed to their success in their STEM program. Not unlike the other studies that have been discussed thus far, the major theme that emerged during student interviews was the need for peer support systems. Other themes included involvement in STEM related activities and high school academic preparation. Participants noted that the availability of positive peer interactions, particularly with students with similar academic and career goals, was important for their success in their majors. Students viewed peer groups as necessary for both academic and social support. Academically, participants of this study desired peer support because of the rigor that was associated with their programs. They discussed the importance of study groups and peer tutoring for academic success in STEM. Socially, peers offered a network for encouragement and

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emotional support in a field of study that is usually very difficult for Black students (Seymour & Hewitt, 1997). Major findings highlighted the value Black students place on peer support.

The following study examines the need for peer support by analyzing a program that was created to address those issues. As Seymour & Hewitt (1997) noted, Black students have a higher probability of being academically and socially isolated on predominantly white campuses and in STEM related majors than White or Asian students. In their mixed methods study, Maton and colleagues analyzed the Meyerhoff Program, a STEM program created with intentions to remedy the issue of exclusion of Black students in STEM fields. The Meyerhoff Program was initiated at the University of Maryland, Baltimore County (UMBC) and involves several aspects intended to increase academic and social integration, which is believed to increase belongingness and persistence in students.

Studying members of the Meyerhoff program as well as students outside of the program, Maton, Hrabowski and Schmitt (2000) examined several aspects, including integration, through a survey and subsequent interviews. Findings suggested that aspects of the program, such as the intensive summer bridge program and the continuous collaboration of the students, increased students' social integration. Students in this program were expected to attend study groups, program meetings, and cohort meetings that kept them integrated throughout their tenure at the university. The researchers found that social integration was important for the achievement of the students and those students that were involved with the Meyerhoff program felt more integrated and often outperformed those students who did not participate in the program. The findings of the study conducted by Maton and Hrabowski greatly contribute to the current study in that they emphasize the need to integrate students into the university environment when being placed in a very demanding field of study. The current study extended this research by

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examining additional programs that are intended to increase integration of students in the academic and social systems of the university.

Summary. Black students can easily become isolated when attending a PWI and in majors where they are usually the minority (i.e., STEM programs), which could be a contributing factor to dropout from these programs and sometimes these universities (Seymour & Hewitt, 1997). The researchers from the studies in this subsection noted that students when felt supported were more likely to succeed in STEM fields (Maton et al., 2000; Palmer et al., 2011). Providing programs that offer academic and social support to the students may lead to student achievement and persistence to graduation. Both studies found that when students were provided with like-minded communities of students that shared academic and career interests, academic achievement and social support was enhanced.

Sense of belonging of college students. The following studies in this subsection examined college students' sense of belonging and how it has influenced motivation and achievement. All of the studies show similar results – sense of belonging is positively related to motivation.

Using Tinto's framework as guidance for their study, Morrow and Ackerman (2012) sought to understand what assisted students in persisting in college. They examined how sense of belonging and motivation predicted students' intentions to persist through college and whether they would stay from freshman year to sophomore year. The researchers used the Sense of Belonging Scale (SBS) to measure sense of belonging, which measured perceived peer support, perceived classroom comfort, perceived isolation, and perceived faculty support. Motivational attitudes were measured using the Academic Attitudes Scale (AAS); there were six subscales: intrinsic value, instrumental value, personal development, external pressure, social interest, and

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no better opinion. Findings supported the notion that sense of belonging plays a role in students' intention to persist. However, they also found that motivation was significant in students' intention to persist and their retention to sophomore year. Faculty support was also a significant predictor for persistence to the next year. The current study extended on this study by further examining, through student interviews, how students' sense of belonging has influenced attitudes and persistence in the university, and more specifically in STEM.

According to research, a combination of motivational attitudes, academic factors, and interpersonal factors promote sense of belonging of college students (Freeman, Anderman, & Jensen, 2007, Morrow & Ackerman, 2012). Freeman, Anderman, and Jensen (2007) conducted a quantitative study to examine many of the same motivational beliefs that Morrow and Ackerman (2012) did and found many of the same results. The purpose of this study was to examine how sense of belonging was associated with motivational beliefs (e.g., task value, self-efficacy, and intrinsic motivation) and achievement. Freeman et al. (2007) examined sense of belonging both on classroom- and university-level. On the class-level, the findings showed that sense of belonging was associated with motivational beliefs and achievement. Findings also suggested that students who felt encouraged and supported in class by their instructor also had a greater sense of belonging to the class than peers with a lower perception of instructional support. This further supports Tinto's model that emphasizes the need for integration and support on the faculty level. On the university-level, the researchers found many of the same findings as they did for the class-level. The current study extended this research by narrowing the population to Black students but still examining their sense of belonging on the university-level and the effects it has on achievement.

Sense of belonging is believed to be context-dependent (Strayhorn, 2012) and to obtain a better understanding of how students fit in in their classrooms research was needed to understand the contextual characteristics of belongingness in the classroom. Zumbrunn, McKim, Buhs and Hawley (2014) conducted a similar study and found similar results as Freeman et al. (2007). However, Zumbrunn and colleagues conducted a mixed methods study, which added an extra layer of depth to understanding class-level belongingness. The purpose of the study was to understand sense of belonging amongst college students with relation to their specific classroom experiences, and specifically to understand the paths between belongingness, motivational beliefs, and achievement. The qualitative portion of the study sought to further understand how contextual factors, such as university experiences, may influence, either positively or negatively, students' sense of belonging. Zumbrunn et al. (2014) found that perceived classroom support from instructors was strongly associated with sense of belonging. Belongingness was also a mediator for students' task value and self-efficacy; self-efficacy was a mediator for engagement, which then predicted student achievement. In summary, instructor support, both academically and socially, was important to many factors – belongingness, task value, self-efficacy, engagement, and achievement. The qualitative results supported these findings. Students who were considered to be high belongingness felt "accepted and supported by their peers" and "respected and valued by their classmates" (p. 678). Zumbrunn and colleagues concluded that college students' sense of belonging play a role in several motivational constructs, as well as achievement. The current study will include many of the same aspects as Zumbrunn et al. (2014) but will extend it to specifically examine students in Black students in STEM programs. As noted, the more specific the domain, the more targeted the information that can be obtained (Strayhorn, 2012).

*Summary***.** Findings were very similar across each of the studies. They all found some evidence to support the importance of support. Faculty or instructor support was a significant predictor for persistence from year-to-year (Morrow & Ackerman, 2011) and sense of belonging (Freeman, et al., 2007; Zumbrunn, et al., 2014). As well, students with higher sense of belonging were also were more likely to have intention to persist through completion. These results were found on both the university- and class-level. Sense of belonging and motivation were also significantly related to one another. Zumbrunn et al. (2014) found there to be indirect effects of belongingness on achievement, this relationship was mediated by engagement. In sum, sense of belonging was related to several academic and social characteristics including self-efficacy, engagement, achievement, and instructor support.

Sense of belonging of Black males in STEM. When conducting the search for studies of sense of belonging with students in STEM majors, the results were extremely limited. The researcher utilized EBSCOhost databases, Academic Search Complete, and Education Research Complete, using the terms *black students, sense of belonging,* and *STEM*, and the search returned one study. Despite the broad search for Black students, the one study that was found specifically targeted Black males. This further shows the gap in the literature in this field and on this topic.

Strayhorn (2015) conducted a two-phase exploratory sequential mixed methods design. The researcher collected quantitative data and followed up with a qualitative phase. The study was conducted solely with Black males in STEM programs. There were 140 participants for the quantitative phase, and 38 of those students participated in the qualitative phase. The current study has some similarities with Strayhorn's (2015), however, the current study extended the work by providing a more general look into sense of belonging with Black students in STEM programs.

The researcher collected data on resilience in school, self-efficacy in students' academic skills, pre-college interest in the STEM field, sense of belonging, and GPA. Interviews were used to obtain richer information about participants' experiences at their institution and in their STEM program, particularly as Black males. Findings from both the quantitative and qualitative phases resulted in three overarching themes: (a) pre-college STEM self-efficacy; (b) concerted cultivation of initial interests in STEM; and (c) sense of belonging in STEM. The third theme was the most relevant to the current study.

Strayhorn (2015) found that Black male STEM majors were more likely to feel a sense of belonging as compared to their Black non-STEM major counterparts. The interviews yielded three subthemes within the overarching theme of "sense of belonging in STEM," they were broken into (a) what belongingness meant to the participants; (b) the importance of having a sense of belonging in STEM; and (c) the role belonging has played in promoting positive outcomes in their STEM field. In general, students felt indifferent about their belonging in their STEM programs. Some students made comments about feeling socially isolated and wanting to run away and hang with friends. The results also further supported the need for support systems, as many of the participants noted that having a peer or faculty member like them made them feel more included. Overall, participants acknowledged the importance of having a sense of belonging on their success in their programs. These findings continue to support the notion that sense of belonging should be viewed as an essential element for humans, especially for students, and even more so for Black in STEM programs, an area where they often feel marginalized (Maton, Hrabowski, & Schmitt, 2000; Seymour & Hewitt, 1997). The current study extended this work by broadening the study's sample to all students instead of just male students, this will

provide more information on how sense of belonging influences Black students in STEM programs.

Summary. Strayhorn (2015) was the lone study that was found when searching for sense of belonging of Black students in STEM programs. Strayhorn found there to be three themes that emerged, one of which was "sense of belonging in STEM." Within this theme, three subthemes emerged, which provided a more in-depth look at what the students believed was most important for persistence and achievement as Black males in STEM programs. Findings suggest that students believe that a sense of belonging is even more important in the success of STEM majors. Negative consequences, such as dropping out, were suggested by several of the findings when students felt like they were being socially isolated. Social inclusion and belongingness is an important factor in the ability to persist and be successful in these programs (Strayhorn, 2015).

The Current Study

The current study relied on the frameworks and theories described in this chapter to address gaps and build on the literature in the field of belongingness. As previously discussed, some of the past research examining sense of belonging amongst college students and Black males in STEM found that programs, such as the Meyerhoff Program or TRiO, may positively influence students' perceptions of inclusion and, subsequently, their academic achievement. The current study sought to contribute to the gap of sense of belonging among Black students in higher education. Further, the researcher narrowed down the population for the current study to STEM majors. Research has shown that universities struggle with recruitment and retention of students in STEM majors; recruitment and retention of Black students in the same fields are even more problematic for universities. Black students in STEM majors often struggle academically

and socially. Achieving a healthy balance of academic and social involvement may be the key to students' success.

Chapter III: Methods

Introduction

Sense of belonging has been examined with K-12 populations, with college students, and even more specifically, with Black male college students. More recently, researchers have concentrated their efforts on Black male college students in STEM programs (Strayhorn, 2015). However, there has been less attention paid to Black males and females in college populations. For this reason, the current research study examined sense of belonging of Black students in STEM programs at a predominantly White institution.

Research Questions

The current research was guided by the following research questions:

R1: Quantitative: Is there a significant difference in sense of belonging between Black STEM students who participate in cohort-supported programs and those who do not participate in these programs?

R2: Quantitative: Is student self-reported GPA associated with age, gender, major, and scores on the adapted Psychological Sense of School Membership scale?

R3: Qualitative: How do Black students describe their perceptions of belongingness at the university and in their STEM programs?

R4: Qualitative: In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program?

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R5: Mixed Methods: How do the experiences of Black STEM students support or contradict the results of students' perceived sense of belonging scale scores?

Research Design

An explanatory sequential mixed method design was employed for the current study. In an explanatory sequential design, the major emphasis is placed on the quantitative phase of the study. With this design, the quantitative phase is conducted first and is followed by the qualitative phase. This design is notated as QUAN → qual. According to Creswell and Plano Clark (2011), an explanatory sequential research design is comprised of four steps. Those steps are: (a) design and implementation of the quantitative phase; (b) use of strategies to decide on what quantitative results need follow-up; (c) design and implementation of the qualitative phase, based on the quantitative results; and (d) interpretation of the results from both phases.

In the first phase, quantitative data were collected and analyzed prior to the second, qualitative, phase. The results from the quantitative phase were used to guide the design and implementation of the qualitative phase. Based on students' quantitative scale scores, participants were invited to participate in follow-up interviews to obtain a more complete understanding of their belongingness in the university and within their major. The qualitative data were collected via one-on-one interviews and analyzed separate from the initial quantitative data. The final step in the explanatory sequential design was to connect and interface the two phases of the design (Creswell & Plano Clark, 2011; Ivankoa, Creswell, & Stick, 2006). The researcher then analyzed the results of both phases. Specifically, the researcher examined how the qualitative results explained or added to the understanding of the quantitative results. Figure 3 provides a diagram of the current study's design phases, procedures, and products.

Phase

- Quantitative Data Collection
- Quantitative Data Analysis
- Case Selection; Interview Protocol
- Qualitative Data Collection
- Qualitative Data Analysis
- Analysis of Quantitative and Qualitative Results

Procedure

- Web-based survey administration (PSSM, demographic information)

- Data screening
- Frequencies and Descriptives
- Reliability testing
- Multiple Regression
- SPSS quantitative software

- Purposive selection of participants from each score group (high/low score; total N = 8)
- Interview protocol will be adjusted based on quantitative results

- Individual in-depth semi-structured face-to-face interviews
- Member checking
- Additional materials collected, as needed

- Transcription
- Coding and thematic analysis
- Theme development
- NVivo qualitative software

- Integration of both quantitative and qualitative phases

Product

- Scale scores
- Numeric Data

- Missing data, univariate and multivariate assumptions
- Descriptive statistics
- Reliabilities
- Model fit analysis

- Qualitative participants/interviews
- Interview protocol

- Text data (interview transcripts)

- Codes and themes

- Discussion of qualitative results relation with quantitative results
- Implications
- Future research

Figure 3. Modified visual model of explanatory sequential design procedures (Creswell & Plano Clark, 2011).

Design rationale. The researcher chose this particular design to assist in explaining the results that may become available during the quantitative phase. A sole quantitative portion would not be sufficient to explain Black students' experiences with belongingness in STEM programs. There are a number of extraneous variables that may contribute to students' sense of

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belonging. For this reason, the qualitative phase provided richer, more in-depth information about possible factors that may hinder or encourage students' sense of belonging.

Specifically, the researcher utilized the follow-up explanations variant to guide the qualitative portion of the study. The follow-up explanations variant is the most common approach in explanatory sequential research designs (Creswell & Plano Clark, 2011). In the follow-up explanations variant design, the qualitative phase is used to explain the initial quantitative results. Participants are invited to participate in the follow-up interviews based on the results of their quantitative phase, these participants may include those with extreme scores (either high or low), or students with unexpected scores. This type of model focuses on gaining an explanation from participants based on their quantitative scores. Researchers often rely on this model when they want to examine a construct or phenomenon but first need quantitative results to select participants (Creswell & Plano Clark, 2011).

The following sections will cover the procedures of the current study including the data collection of both the quantitative and qualitative phases of the study, the analysis of the data for both phases, and the considerations for the university's Institutional Review Board process.

Quantitative Phase

Participants and setting. The sample was obtained from a large, urban university in the Mid-Atlantic United States. To maintain confidentiality of participants, the researcher will refer to the university as LUU (large, urban university) for the remainder of the paper. Additionally, student cohort programs were changed to pseudonyms to maintain confidentiality. Some of the programs listed are unique to the university in which the data was collected.

To be eligible for the study, students had to meet each of the following criteria: (a) declaration of an academic major in a STEM related field; (b) enrollment in the university as a

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full-time student; (c) being between the age of 18 and 24; and (d) identification as Black or African-American. Participants in their first-year, first semester were excluded from the study because of the time that is generally needed to form a sense of their experiences in the university (Strayhorn, 2015). According to Meyers, Gamst and Guarino (2013), each scale item should have between five and 10 responses to have enough power for many multivariate analyses, with 10 responses being the most stringent requirement. With this rule of thumb, and with 20 items, the researcher sought to obtain at least 100 participants. The targeted sample size for the quantitative phase was between 100 and 125 participants; however, due to lack of participation, the researcher was unable to obtain this amount. The final sample size was 89 participants for the quantitative phase.

   Recruitment. Students were recruited using several methods. Recruitment for this study began in March 2016, following the approval of the researchers' dissertation committee and the Institutional Review Board at the university. A link to participate in the study was sent to program directors and professors in departments across the university who had access to students in science, technology, engineering, or math majors (STEM). Students also were recruited from the Louis Stokes Alliance for Minority Participation (LSAMP), which is a nationwide National Science Foundation (NSF) program intended to increase recruitment and retention of minority students in STEM fields. LUU hosts this program and has a summer-bridge component. The Division for Health Science Diversity was another source of recruitment. This Division has access to a number of on-campus living learning communities and students that are pursuing STEM majors. Advancement (program pseudonym) is a program that is housed in the Division and was used as a means for recruitment. The program includes a summer-bridge and a living learning aspect, and targets incoming freshmen that are interested in health science majors.

Additional recruitment included reaching out to student organizations that had access to student contact information. The following student organizations were contacted and were asked to assist in the recruitment of student participants: African Student Union; Black Student Union; Dental Club at LUU; Engineers Without Borders; Exercise Science Club; Forensic Science Student Club; Health Occupations Students of America; Mathematical Sciences Club; Minorities in Agriculture, Natural Resources, and Related Sciences; Minorities Increasing Participation in STEM; Minority Association for Pre-Health Sciences; National Pan-Hellenic Council; Nursing Students without Borders; Pre-Med Society; Pre-Occupational Therapy Society; Pre-Physical Therapy Society; Pre-Veterinary Medicine Club; Society of Bioinformatics; and Society of Physics Students.

Recruitment emails were sent to program directors, professors, academic advisors, and organization leaders. The recruitment email can be found in Appendix C. The email included the information sheet (Appendix E) and a link to the survey (Appendix A). The information sheet included information for prospective participants and provided informed consent information. The information sheet was also attached to the online survey to ensure access to the document. The first recruitment email was sent out on March 16, 2016. The last recruitment reminder email was sent out on April 26, 2016. The survey was available for approximately one and a half months. A reminder email (see Appendix D) was sent to recruitment sources every two weeks for one month.

Sample. To be eligible for the study, students had to meet several inclusion criteria. They were: a) identify as Black or African American; b) be enrolled in the university full-time; c) have a declared major in a STEM related field; d) be between the age of 18 and 24; and e) be at least a second-semester freshman or higher. In total, 124 participants began the survey, of

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which 10 were partially completed and were removed for incompleteness prior to the analysis.

Another 21 of the cases were removed because the participants did not meet the initial inclusion

criteria that were to be answered prior to the start of the survey. Four additional surveys were

completed but were removed due to the declared majors of the participants. Three students

identified as being psychology majors and one identified as a psychology/sociology major,

neither of which fell within the STEM field. After excluding these cases, 89 complete cases

remained.

Demographic information of the participants' can be found in Table 2. Of the 89

complete responses, 64 students (72%) identified as female and 23 (26%) identified as male;

there were two missing cases in which participants did not provide gender information. Table 2

displays the 89 eligible survey participants; these were used in the subsequent analyses.

Table 2

Demographics of Eligible Survey Participants

Item	Response	Frequency	Percentage
How old are you?	18	16	18
	19	24	27
	20	13	14.6
	21	20	22.5
	22	11	12.4
	23	5	5.6
What is your major?	Biochemistry	2	2.2
	Bioinformatics	1	1.1
	Biology	36	40.4
	Biomedical Engineering	3	3.4
	Chemical Engineering	3	3.4
	Clinical Lab Sciences	2	2.2
	Computer Science	3	3.4
	Environmental Science	2	2.2
	Forensic Science	9	10.1
	Health, Physical education and Exercise science (HPEX)	8	9
	Information Systems	2	2.2
	Interdisciplinary Science	1	1.1
	Mathematics	5	5.6
	Mechanical Engineering	6	6.7
	Physics	1	1.1
	Science	2	2.2

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			Of Total	Of Those in Cohorts
	Two or More Majors	2	2.2	
What gender do you	Male	23	25.8	
most identify with?	Female	64	71.9	
	Missing	2	2.2	
What is your estimated	Less than 2.0	0	0	
cumulative college	2.0 – 2.4	3	3.4	
GPA?	2.5 – 2.9	22	24.7	
	3.0 – 3.4	42	47.2	
	3.5 – 4.0	21	23.6	
	Missing	1	1.1	
What is your academic	Second-semester freshman	28	31.5	
standing?	Sophomore	19	21.3	
	Junior	22	24.7	
	Senior	20	22.5	
Have you been or are	No	59	66.3	
you currently involved	Yes	28	31.5	
in a cohort program?	Missing	2	2.2	
Which program?			Of Total	Of Those in Cohorts
	[Advancement]	8	8.9	28.6
	[Strive]	3	3.4	10.7
	[Orb]	5	5.6	17.8
	[Pre-College Program]	1	1.1	3.6
	[Edge]	2	2.2	7.1
	LSAMP	5	5.6	17.8
	Summer-bridge program	1	1.1	3.6
	Two or more programs	3	3.4	10.7

The breakdown of students by major was representative of the university's population of Black students. From the majors that were surveyed in this study, there were approximately 1300 students in those majors at the university level. Out of all the majors included in the study, Biology, HPEX, and forensic science enrolled the most students in the university; and the majority of study participants were affiliated with these majors. Of the 1300 students that made up the population of Black students at the university, approximately 30% were biology majors. Similarly, the study sample of biology students represented approximately 40% of those surveyed. There was a ratio of nearly 11:1 for the total population of Black students in biology to that of students that participated in the survey. HPEX had a ratio of 74:1, and forensic science had a ratio of 9:1 of those in these majors in the university and those who were included in the

study. The population of Black students in the remaining sampled STEM majors in the university were far fewer when compared to biology and HPEX; this was represented in the low sampling of the remaining majors within the study.

Measures.

Demographic questions. Participants were asked to answer several demographic questions to provide background information that may be relevant to their perceived sense of belonging. Students were asked to respond to questions regarding their age, major, gender, estimated current grade point average (GPA), estimated high school GPA, academic standing (i.e., freshman, sophomore, etc.), and whether they had been or are currently involved in a cohort-supported program. Despite some contentions around collecting self-reported student grades, Cassady (2001) was able to provide evidence to show that the use of self-reported GPA is highly reliable ($r = .97$), suggesting that students are able to accurately report their actual GPA. Participants were asked to provide their age to ensure that they were at least 18 years of age and at most 24 years of age. All other demographic information was collected for use in the analyses. Five questions related to the inclusion criteria of the study were included in the beginning of the survey. These questions required a positive response from participants prior to starting the demographic questionnaire and the subsequent survey questions. To ensure that participants met all of the inclusion criteria, potential participants were asked: (a) "Is your declared major in a STEM related field?" (b) "Are you enrolled in the university full-time?" (c) "Are you between the ages of 18 and 24?" (d) "Do you identify as being either Black or African American?" (e) "Are you at least a second-semester freshman or higher?" The particular age range of 18 to 24 was used because according to sources, this is the age range of traditional full-time students at a four-year institution (Bean & Metzner, 1985; Hurtado, Kurotsuchi, & Sharp, 1996). Once a positive response was reported for each of the inclusion criteria questions,

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participants were allowed to proceed to the survey. Negative responses to any of the inclusion criteria questions prompted a dialogue box to appear on the screen informing the students of the end of the survey.

Psychological Sense of School Membership Scale. To measure sense of belonging amongst undergraduate students, a modified version of the Psychological Sense of School Membership (PSSM) was used. A complete list of survey items can be found in Appendix A. Goodenow (1993b) initially created the PSSM to measure school membership perceptions and belongingness of middle school aged children. Zumbrunn et al. (2014) later modified the scale to target college-aged students. Although the adapted scale that was used for the current study is aligned to the same population, Zumbrunn and her colleagues were specifically interested in measuring belongingness at the classroom level. All items used in the Zumbrunn et al. (2014) study were used for the current study; however, wording was adapted to focus on a more general sense of belonging to the university and major, instead of the classroom. The current study added to the literature by expanding on both the original scale and the scale adapted by Zumbrunn et al. (2014) to further measure university and program belongingness.

The original scale (Goodenow, 1993b) has been used and validated in several studies (Freeman et al., 2007; Zumbrunn et al., 2014). Overall, the scale has been found to have good psychometric properties. According to the original study (Goodenow, 1993b), Cronbach's alpha scores for the scale ranged from .77 to .87. Alphas were calculated for several populations in the multi-part validation study. The first portion of the study was conducted with middle school students in a suburban district. This population had the highest internal consistency reliability (α = .875), which represents good reliability. The lowest reliability coefficient was found when administering the Spanish version in an urban school setting (α = .771; Goodenow, 1993b).

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Although this coefficient is slightly lower than the first study, it is still adequately reliable (George & Mallery, 2003).

Zumbrunn et al. (2014) adapted the PSSM to measure "college students' perception of belonging" (p. 667). Using the original language of the PSSM as the foundation, items were adapted to target classroom (rather than school) belonging. For instance, an item from the original scale was "People at this school are friendly to me." The revised version of this item in Zumbrunn and colleagues study was "Students in this class are friendly to me." The same item for the current study was slightly revised to reflect the context in which the belongingness will be measured: "People at this university are friendly to me." Apart from revisions in wording of the original scale, Zumbrunn et al. (2014) also added two new items. The additional items were: "I can talk to others if I have a problem" and "In this class, I am included in group work." The wording of these items were reworded for the current study to read "There are other students in my program that I feel comfortable talking to if I have a problem" and "I feel included when completing group work." Reliability estimates for the current scale were conducted to understand how the adaptations may have changed the scale structure, if at all. The measure that was tested included 20 items on a 5-point Likert scale, ranging from strongly disagree to strongly agree. The reliability estimates of the newly adapted scale was found to be reliable ($\alpha = .86$), which was comparable to the original scale by Goodenow (1993b).

Although the PSSM scale may appear to only target the social side of belonging; the items that appear on the scale are related to both academic and social integration. Academic integration is associated with not only grade point average but the involvement of students in the academic community (Tinto, 1993; Strayhorn, 2012). According to Tinto's (1993) model, there are both formal and informal states within both the academic and social system. While the

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formal state of the academic system is academic performance, the informal state of this system is the involvement or interactions within the university community. Similarly, the social system also involves a formal and informal state; the formal aspect of the model included activities and programs that the students are involved in and the informal portion of the model involves interactions among peers. Despite the scale not directly addressing academic performance in terms of grades, the scale does address interactions and integration of students. A sample item that addresses this is "I feel included when completing group work." This item may initially seem to be more relevant to the social system of belongingness, however, it more directly relates to the academic system as it takes in account the work being completed in the classroom. The item emphasizes the need for academic support between peers. According to Tinto (1993), interactions with faculty and staff are included within the academic system of belongingness. This aspect of the model was also addressed in the PSSM scale, "Most professors in my program are interested in my work." The interactions within the academic systems extend pass grade point averages or test performances, to the development of a supportive educational community (Tinto, 1993).

Data collection procedures. The adapted version of the Psychological Sense of School Membership (PSSM) was administered to students via RedCap, a tool used by the university to build, administer, and store survey data. A demographic section was also included in the survey. The survey took students approximately 7 to 10 minutes to complete. Students were able to complete the survey on their personal computers. If a personal computer was not available, students were able to use a campus computer. Some students were given the opportunity to take the survey on classroom iPads. Students were not required to take the survey in a designated area. Identifiable information was collected at the end of the survey and only if the student was

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willing to participate in the qualitative follow-up phase of the study. Students who were willing to participate in the follow-up phase were asked to provide either their phone number or email address so they could be contacted if selected for the qualitative portion of the study.

Students were required to identify as a consenting adult prior to beginning the survey. Students who did not meet the requirement of being at least 18 year or older were not allowed to participate in the study. A dialogue box appeared on the screen to inform underage students that they did not meet eligibility requirements to participate in the survey and that the survey would end.

Data analysis procedures. Prior to conducting primary analyses, data were screened for a variety of assumptions and missing data. Several steps were taken to analyze the survey data and to answer the proposed quantitative research questions. Descriptive analyses were conducted to observe any significant information that may be present in the data. Descriptive statistics of the data provided information on the measures of central tendency (e.g., mean, median, and mode). Maximum, minimum, and range statistics were examined to determine the presence of outliers, skewness, or extreme scores.

Quantitative data were screened for missing data by running frequencies on the raw data. Cases with more than half of the survey response missing were deleted. Further explanation of deleted cases is included in the Preliminary Analyses section of Chapter Four – Findings. Data was then evaluated for univariate and multivariate assumptions. Skewness and kurtosis were evaluated through the use of the skewness and kurtosis statistics and through histogram displays. The data met this assumption; a table with the descriptive statistics, skewness, and kurtosis can be found in Table 3. There were no outliers in the data, and the skewness and kurtosis were within the suggested ranges (Field, 2013). Levine's Test was examined to test for homogeneity

of variance. A correlation matrix output was used to observe if there was multicollinearity

among the variables and can be found in Table 4.

Table 3

Descriptive Statistics, Skewness, and Kurtosis for All PSSM Items

	Min	Max	*M*	*SD*	Skewness	Kurtosis
I feel like a part of the university.	1	5	3.31	.86	-.44	-.07
Sometimes I feel as if I don't belong at this university.*	2	5	4.04	.98	-.44	-1.1
As a student, there are a lot of activities that I can participate in at the university.	1	5	4.07	.86	-1.00	1.25
I can really by myself at this university.	1	5	3.88	.93	-.89	.91
I wish I were at a different university.*	1	5	4.27	.94	-1.07	.47
I feel proud of belonging to this university.	1	5	3.66	1.01	-1.03	.93
There's at least one professor at this university that I can talk to if I have a problem.	1	5	2.85	1.34	.04	-1.27
People at this university are friendly to me.	1	5	3.69	.92	-.83	.95
Professors here are not interested in people like me.*	1	5	4.30	.95	-1.39	1.41
In the university, I am treated with as much respect as my peers.	1	5	3.57	.84	-.59	.85
People in my program notice when I'm good at something.	1	5	2.93	1.21	-.14	-1.01
It is hard for people like me to be accepted in my program.*	1	5	3.94	1.03	-.70	-.14
Other students in my program take my opinions seriously.	1	5	3.19	.98	-.25	-.05
Most professors in my program are interested in my work.	1	5	2.92	1.14	-.12	-.62
I feel very different from most other students in my program.*	1	5	3.57	1.25	-.49	-.71
The faculty and staff in my program respect me.	2	5	3.65	.80	-.38	-.19
People in my program know I can do good work.	1	5	3.27	.99	-.57	.1

Other students in my program like me the way I am.	2	5	3.62	.86	-.38	-.43
There are other students in my program that I feel comfortable talking to if I have a problem.	1	5	3.53	1.18	-.58	-.53
I feel included when completing group work.	1	5	3.45	.99	-.29	-.46

Note: Asterisk (*) denote items that were reversed coded.

An independent samples *t*-test was conducted to answer the first quantitative research question: "Is there a significant difference in sense of belonging between Black STEM students who participate in cohort-supported programs (*n* = 28) and those who do not participate in these programs (*n* = 59)?" The independent samples *t*-test allowed the researcher to determine if scores on the PSSM differed based on students' membership in a cohort-supported program.

A multiple regression was conducted to answer the second quantitative research question: "Is student self-reported GPA associated with age, gender, major and scores on the adapted Psychological Sense of School Membership scale?" The predictor variables for this analysis were sense of belonging scale scores on the PSSM, utilizing the subscales that were found when conducting the Principal Component Analysis (PCA); age; gender; self-reported high school GPA; academic standing; major/department; and number of Black full-time faculty members in the department. The number of Black full-time faculty was acquired by searching the website of the department in which each participant identified; this measure was not self-reported. A multiple regression analysis was used to determine how much variation in student GPA scores was explained by each of the predictor variables (Meyers, Gamst, & Guarino, 2013). In past research, sense of belonging and high school grade point average was found to significantly predict student academic success (Strayhorn, 2015).

Validity. According to the *Standards for Educational and Psychological Testing* set out by the American Educational Research Association (AERA), American Psychological Association (APA), and the National Council on Measurement in Education (NCME), validity is considered to be "the most fundamental consideration in developing and evaluating tests" (p. 11). Although the PSSM is not a new measure, adjustments were made, and with these adjustments the researcher would like to be sure the interpretations drawn from the instrument will support and align with theory and other previously validated scales. There are several sources of evidence that can be used to evaluate the validity of the interpretations obtained for a test or survey. The following sections outline those sources that most pertain to the measure and interpretations of this study.

Content-oriented evidence. Content-oriented evidence can be obtained by examining the relationship between the items on the survey and the construct that is being studied (AERA, APA, & NCME, 2014). For this study, the PSSM and its relationship to the construct of belongingness are important for developing evidence of test content. The researcher evaluated content-oriented evidence by reviewing the literature of both sense of belonging and the PSSM scale. The revised PSSM was constructed by examining the original scale developed by Goodenow (1993b) and the modified scale established by Zumbrunn et al (2014). Care was taken to ensure that all items aligned with the intended purpose of the survey and the construct being measured.

Although the adapted PSSM contains many of the same items of the original survey, wording was changed to reflect its use in higher education settings, specifically with Black students, and the unit of analysis (i.e., university instead of classroom).

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Evidence regarding internal structure. The PSSM items and the components of the scale were evaluated for internal structure to ensure the construct and interpretations were analyzed as intended (AERA et al., 2014). This description may sound very familiar to the source of evidence described earlier. However, content-oriented validity focuses on the appropriateness item content while evidence of internal structure involves the relationship between items and the selection procedure of the items included in the scale. The structure of the scale should model the theoretical model or framework from which it was derived. According to the original publication on the validity of the PSSM, the 18-item scale loaded onto one factor (Goodenow, 1993b). Zumbrunn et al. (2014) later added two additional questions that also highly loaded to the same factor of the original 18-item scale. The researcher of the current study examined evidence of internal structure to identify the factor structure associated with the scale. Though there has been evidence to show that the PSSM is measured on a one-factor component, other studies suggest a three-factor model of belongingness (Freeman, Anderman, & Jensen, 2007).

A principal component analysis (PCA) was conducted to examine evidence regarding internal structure. A PCA is used to identify a smaller set of components or factors from a larger set of variables or items. During the analysis, a determination is made as to which items have the most in common with one another. This distinction creates the components or factors that were described earlier (Meyers, Gamst, & Guarino, 2013). According to O'Rourke and Hatcher (2013), the sample size for conducting a PCA should be five times the number of items that are being measured. There were 20 items used in the current study, which would require complete responses from at least 100 participants (Maas & Hox, 2006; O'Rourke & Hatcher, 2013). As discussed earlier, due to issues with participant recruitment, the researcher was unable to obtain

the required amount of 100 participants; instead the researcher was able to obtain 89 complete responses.

As there is some disagreement on the number of factors of the PSSM (Freeman et al., 2007; Zumbrunn et al., 2014), conducting a PCA allowed the researcher to explore whether the current items contribute to either a one- or three-factor model, or possibly another model. Along with determining the number of components, a PCA allowed the researcher to identify which items loaded onto each of the components. If PCA evidence suggests that there is only one component that makes up the majority of the cumulative variance, more than likely all of the items will load onto that component. Ideally, each item will demonstrate a simple structure (e.g., item 1 has a loading of greater than .40 on component 1 and less than .30 on another component) (Meyers, Gamst, & Guarino, 2013). PCA loadings were used to determine the number of factors evident within the scale.

Prior to running the PCA, the researcher ensured that the data was suitable. Despite not meeting the rule-of-thumb of having at least 100 observations or 5 times the amount of variables, the researcher decided to check each assumption associated with conducting with the PCA. After doing so, the researcher used best judgment and decided to continue with the analysis, while interpreting the results with caution.

The assumptions that were discussed earlier in this chapter were applied when determining whether the data was suitable for a PCA. Additional assumptions were required to be met for a PCA to be conducted. Using Pearson correlation, the researcher found that there was one item, item three, that did not have at least one correlation above .30 with another item. The item was: "As a student, there are a lot of activities that I can participate in at the university." This item was removed prior to the start of any subsequent analysis. When

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examining the item, the researcher was unable to determine the reason for the low correlations with the other items. Based on the literature and past validation studies, this item aligned and correlated with the other items. The change in wording could have had a possible impact on how students answered this particular item. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was used to test the assumption of sampling adequacy. According to Field (2013), a desirable value for the KMO test is at least .60, or what he explained as being "mediocre" (p. 685), KMO was .81 for all the items of the survey, minus the one item deleted due to low correlation. Lastly, to test for suitability of data reduction, the Bartlett's Test of Sphericity was conducted. This test presented a significant outcome signifying that the items were significantly different from zero.

Table 4

Mean, Standard Deviations, and Correlations among Sense of Belonging Variables

	M	SD	Q1	Q2R	Q3	Q4	Q5R	Q6	Q7	Q8	Q9R	Q10	Q11	Q12R	Q13	Q14	Q15R	Q16	Q17	Q18	Q19	Q20
Q1	3.31	.86		.31	.17	.36	.29	.48	.25*	.35	.10	.09	.29	.08	.32	.22*	-.01	.16	.29	.35	.36	.38
Q2R	4.03	.98	.31		-.02	.48	.46	.22*	.33	.37	.21*	.14	.14	.08	.15	.12	.16	.06	.15	.28	.37	.28
Q3	4.07	.86	.17	-.02		.11	.03	.18	.06	.10	.09	.26*	.12	.05	.21*	.04	-.05	.26*	.23*	.20	.18	.12
Q4	3.88	.93	.36	.48	.11		.43	.43	.39	.39	.07	.08	.25*	.18	.15	.23*	.06	.25*	.20	.42	.35	.32
Q5R	4.27	.94	.29	.46	.03	.43		.43	.32	.32	.25*	.16	.12	.004	.24*	.22*	.03	.20	.14	.17	.25*	.03
Q6	3.66	1.01	.48	.22*	.18	.43	.43		.23*	.49	.06	.24*	.20	.05	.34	.19	-.01	.19	.25*	.27	.31	.18
Q7	2.85	1.34	.25*	.33	.06	.39	.32	.23*		.27*	.36	.09	.23*	.17	.24*	.14	.19	.22*	.37	.21	.19	.10
Q8	3.69	.92	.35	.37	.10	.39	.32	.49	.27*		.28	.53	.18	.16	.42	.15	.09	.39	.24*	.39	.30	.35
Q9R	4.30	.95	.10	.21*	.09	.07	.25*	.06	.36	.28		.47	.22*	.19	.35	.38	.19	.49	.39	.21*	.16	.33
Q10	3.57	.84	.09	.14	.26*	.08	.16	.24*	.09	.53	.47		.17	.10	.41	.14	.15	.54	.35	.29	.22*	.26*
Q11	2.93	1.21	.29	.14	.12	.25*	.12	.20	.23*	.18	.22*	.17		.02	.50	.48	.003	.36	.59	.42	.33	.46
Q12R	3.94	1.04	.08	.08	.05	.18	.004	.05	.17	.16	.19	.10	.02		.11	.10	.36	.19	.11	.14	.27*	.28
Q13	3.19	.98	.32	.15	.21*	.15	.24*	.34	.24*	.42	.35	.41	.50	.11		.45	.002	.42	.57	.35	.26*	.38
Q14	2.92	1.14	.22*	.12	.04	.23*	.22*	.19	.14	.15	.38	.15	.48	.10	.45		.02	.51	.48	.35	.26*	.47
Q15R	3.57	1.25	-.01	.16	-.05	.06	.03	-.01	.19	.09	.19	.15	.003	.36	.002	.02		.24*	.17	.18	.18	.14
Q16	3.65	.80	.16	.06	.26*	.25*	.20	.19	.22*	.39	.49	.54	.36	.19	.42	.51	.24*		.60	.47	.23*	.42
Q17	3.27	.99	.29	.15	.23*	.20	.14	.25*	.37	.24*	.39	.35	.59	.11	.57	.48	.17	.60		.47	.22*	.39
Q18	3.62	.86	.35	.28	.20	.42	.17	.27*	.21	.39	.21*	.29	.42	.14	.35	.35	.18	.47	.47		.45	.62
Q19	3.53	1.18	.36	.36	.18	.35	.25*	.31	.19	.30	.16	.22*	.33	.27*	.26*	.26*	.18	.23*	.22*	.45		.61
Q20	3.45	.99	.38	.28	.12	.32	.03	.18	.10	.35	.33	.26*	.46	.28	.38	.47	.14	.42	.39	.62	.61	

Figures in boldface indicate the correlation is significant at the 0.01 level. * indicate the correlation is significant at the 0.05 level.

Prior to arriving at the final model, the research engaged in several rounds of principal component analysis (PCA). A principal component extraction technique was used with an orthogonal varimax rotation. In the first round of analysis, 19 items were submitted to the PCA, with item three being excluded due to its lack of correlation to the other items. Initially, the researcher allowed SPSS to determine the component structure by allowing the software to choose the structure based on eigenvalues greater than 1, a five-structure model emerged. In this model, the five components made up 68.6% of the variance. The five factors comprised 34.9%, 11.8%, 8.6%, 7.0% and 6.2% of the variance, respectively. A scree plot (Figure 4) inspection revealed that two components might fit the model better than the five-structure model that initially emerged. Upon inspection of the rotated component matrix, the values further confirmed what was evident in the scree plot output. The researcher found that many of the items did not achieve simple structure and that on the fifth factor there were only two items. The factor loadings five-component model can be found in Table 5.

Table 5

Summary of Principal Component Analysis using Principle Component with Varimax Rotation for PSSM Scale, Initial Five-Component Model

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
People in my program know I can do good work.	**.80**	.13	.12	.17	.09
Most professors in my program are interested in my work.	**.74**	.08	.22	.003	-.01
People in my program notice when I'm good at something.	**.73**	.09	.34	-.07	-.12
Other students in my program take my opinions seriously.	**.62**	.14	.18	.40	-.14
The faculty and staff in my program respect me.	**.61**	.02	.12	.48	.25
Professors here are not interested in people like me.	**.51**	.17	-.17	.40	.38
I wish I were at a different university.	.10	**.76**	-.04	.20	-.07
Sometimes I feel as if I don't belong at this university.	-.004	**.67**	.26	.05	.19
I can really by myself at this university.	.09	**.66**	.41	-.01	.06
There's at least one professor at this university that I can talk to if I have a problem.	.35	**.66**	-.14	-.05	.30
I feel proud of belonging to this university.	.05	**.52**	.32	.38	-.29
I feel included when completing group work.	.41	-.03	**.75**	.13	.21
There are other students in my program that I feel comfortable talking to if I have a problem.	.12	.23	**.71**	.09	.21
Other students in my program like me the way I am.	.38	.14	**.61**	.18	.14
I feel like a part of the university.	.17	**.43**	**.50**	.09	-.20
In the university, I am treated with as much respect as my peers.	.21	-.01	.05	**.86**	.14

People at this university are friendly to me.	.05	.38	.32	**.70**	.01
I feel very different from most other students in my program.	.02	.07	.05	.07	**.77**
It is hard for people like me to be accepted in my program.	.00	.03	.27	.06	**.67**
Eigenvalues	6.05	2.01	1.54	1.45	1.19
% Variance explained	34.9	11.8	8.6	7.0	6.2

Because the researcher did not find the five factors model to be the best fit, several other models were explored. Using SPSS, a fixed number of components was selected. The researcher first examined the two-factor model to determine whether the results of the scree plot were accurate. Two items, items 12 and 15, were excluded when subjected the PSSM to the two factor model. A final PCA was conducted with 17 items on a two component model. Table 6 displays the factors and communalities of the final model. The results of the PCA allowed the researcher to determine that the two-component model was the best fit, which lead the researcher to examine each item to see if each component was theoretically supported. Upon examination, the researcher found that items seven and 18 did not appear to group with the other items, they did not fit theoretically. The deletion of these items made sense after further examination of the factor loadings. Item 18 was cross-loaded slightly, and item seven had a low factor loading on component two. The final model without items 3, 7, 12, 15, and 18 can be found in Table 6.

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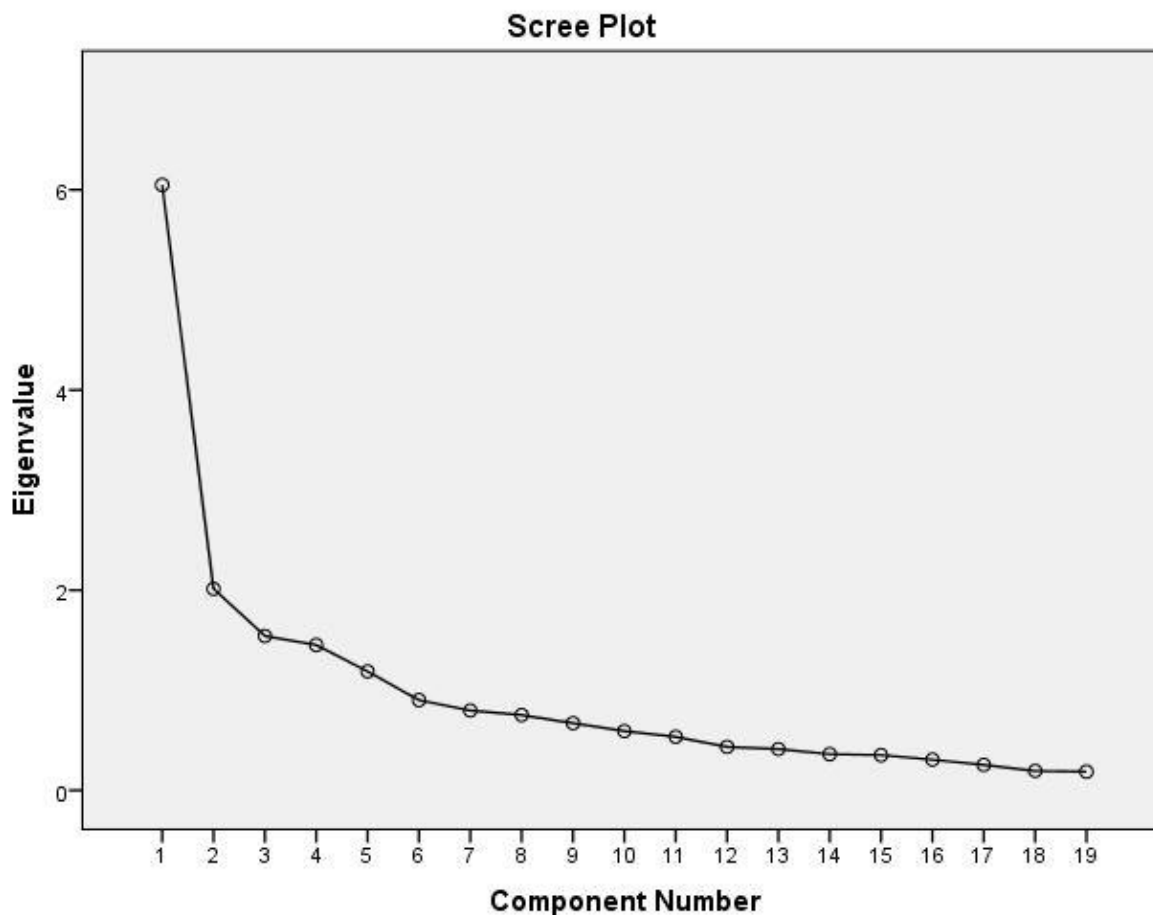
Figure 4. Scree plot for initial five-component model

Although the final model (48%) accounted for less variance than the initial five-component, several other aspects were examined and found to be suitable. The KMO of .81 of the two-component suggested that the model was suitable. This model also aligned more with the scree plot that was the result of the initial five-component model (Figure 5). To confirm that the subscales were sufficient, the researcher subjected each of the subscales to reliability testing. The researcher first ran reliability tests on the two-component model that included items seven and 18, upon examination, the researcher found that component two would benefit from the deletion of item seven, which supported the lack of theoretical fit explained previously. Factor

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one had an acceptable and strong reliability (α = .85). Factor two also produced a strong

reliability (α = .80).
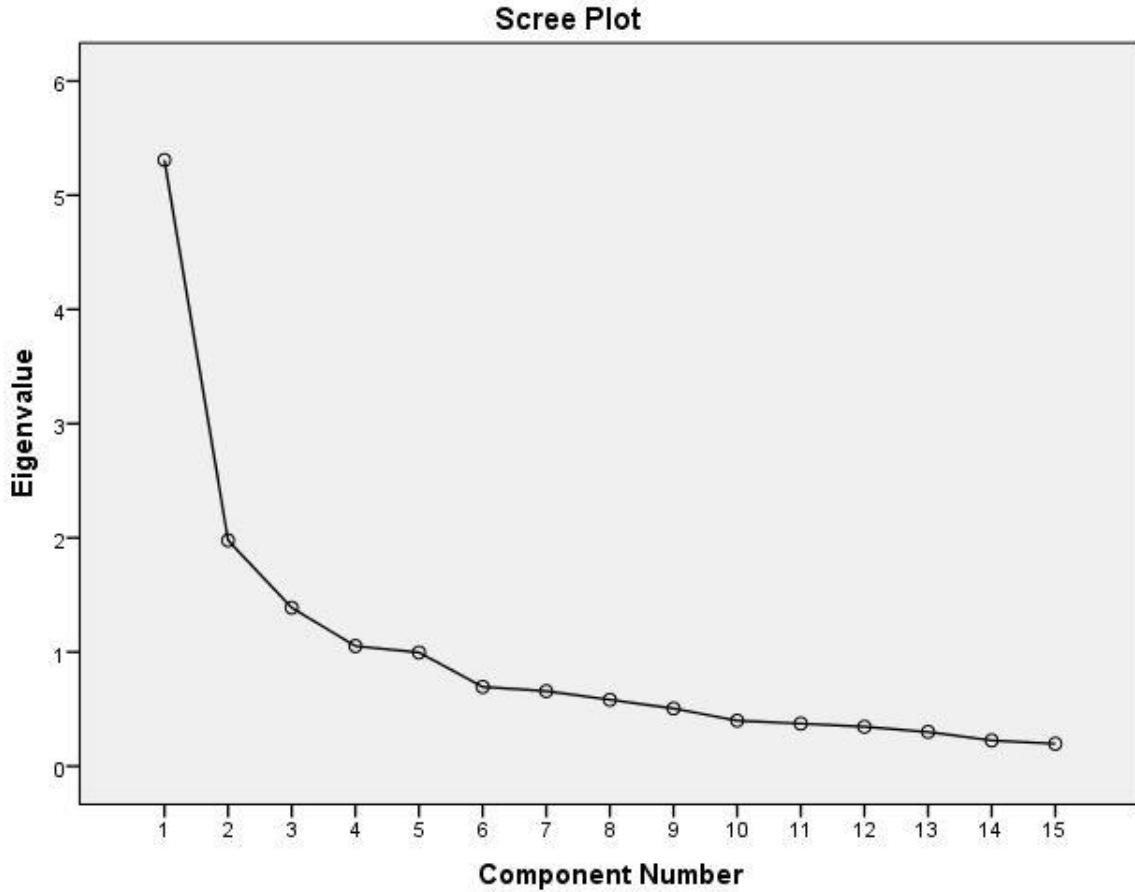
Figure 5. Scree plot for 15-item scale

As discussed earlier, past research showed that the scale would likely either include one

or three components. To confirm the two-factor structure, the researcher forced extractions for

both one- and three-component models. Upon examining the three-component model, using the

same technique described earlier, the researcher found many of the items would need to be

removed due to the lack of simple structure. With a one-component model, all item loadings

were above .40; however, the two-component model explained more of the variance than the

one-component model, 48% and 35%, respectively. The researcher chose the two-component as

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the best fit because it appeared to be the best model given the scree plot, KMO, simple structure,

variance explained, and reliability estimates.

Table 6

Summary of Principal Component Analysis Using Principle Component with Varimax Rotation for Final 15-item, Two-Component Model

Item	Factor 1 (Interactions, α = .85)	Factor 2 (Welcoming/Belonging, α = .80)	Communality
The faculty and staff in my program respect me.	**.79**	.10	.63
People in my program know I can do good work.	**.79**	.12	.63
Other students in my program take my opinions seriously.	**.70**	.23	.55
Most professors in my program are interested in my work.	**.68**	.13	.48
People in my program notice when I'm good at something.	**.65**	.18	.45
Professors here are not interested in people like me.	**.64**	.06	.41
I feel included when completing group work.	**.59**	.34	.47
In the university, I am treated with as much respect as my peers.	**.58**	.15	.36
I can really by myself at this university.	.09	**.74**	.56
Sometimes I feel as if I don't belong at this university.	.03	**.70**	.49
I feel proud of belonging to this university.	.16	**.67**	.49
I wish I were at a different university.	.07	**.65**	.45
I feel like a part of the university.	.20	**.63**	.44
People at this university are friendly to me.	.35	**.60**	.48
There are other students in my program that I feel comfortable talking to if I have a problem.	.30	**.55**	.40
Eigenvalues	5.31	1.98	
% Variance explained (Total)	35.39	13.18	Total: 48.57

Need for Follow-up Data

The qualitative phase was used as a follow-up to the quantitative procedures and analyses. By only administering the survey, the researcher could possibly miss out on more in-depth information that may be obtained from in-depth, in-person interviews. Questions that may arise after the quantitative analysis can be answered through the use of one-on-one interviews. Qualitative follow-up data allowed the researcher to understand possible influences of the students' quantitative belonging scores, why the students answered in ways that they did, and how their experiences may influence their sense of belonging.

The follow-up, qualitative phase was guided by two research questions: "How do Black students describe their perceptions of belongingness at the university and in their STEM programs?" and "In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program?" These questions allowed the researcher to gain a richer observation of students' perceptions of belonging. There are a variety of confounding variables, including past and current experiences, that could contribute to students' sense of belonging and conducting the interviews allowed the researcher to parse out these variables from those that actually may have an impact. Interviews allowed the researcher to understand the components of students' university and program experiences that influenced their sense of belonging to the university.

Qualitative Phase

Participants and setting. The sample for the qualitative phase of the study consisted of a subsample of those participants from the initial quantitative phase. A minimum of eight interviews was the target for the qualitative phase of this study. Four interviews were conducted with students who participated in a cohort supported program, two of those were with students in

the low belonging group and two were from the high belonging group. The same was done for

students who had not participated in a cohort program. Standard deviation values determined

group membership. Whereas students with PSSM scores one standard deviation or more below

the mean were categorized as the low belongingness group; students with PSSM scores one

standard deviation or more above the mean were placed in the high belongingness group.

Recruitment. The explanatory sequential follow-up explanations variant model calls for

participants of the qualitative phase of the study to be chosen based on specified results that need

to be expanded upon and further explained. At the end of the survey, participants were asked if

they were willing to participate in follow-up interviews. Only quantitative data were used for

students who were not interested in participating in the second follow-up phase of the study.

There was no penalty for not choosing to participate in the second portion of the study. Inclusion

criteria for the qualitative portion included: (a) declaration of an academic major in a STEM

related field; (b) enrollment in the university as a full-time student; (c) being between the age of

18 and 24; (d) should identify as Black or African-American; and (e) opt-in during the

quantitative phase. A diverse sample of the willing students was selected based on students'

scores on the PSSM, gender, and involvement in a cohort-supported program.

Participants assigned to the high and low belonging groups were contacted to participate

in the follow-up interviews. To select participants, the researcher used the method utilized by

Zumbrunn et al. (2012), which was to determine the mean ($\bar{x} = 3.59$) and standard deviation (SD

= .54) and then subtract or add the standard deviation to the mean to determine the cutoff for

participants in the low or high belonging groups. After subtracting the standard deviation from

the mean, the research found the threshold to be 3.05 and below for the low belonging group,

those below this value were included in the low belonging group (N = 18). Similarly, for those

in the high belonging group, the standard deviation was added and the threshold began at 4.13, those above this value were also included in the high belonging group (N = 11). There were 29 total students in the low and high belonging groups. However, only 16 students provided their contact information and were willing to participate in the follow-up phase of the study. With the use of this process, the researcher found that the mean range for the low belonging group was 2.30 and 3.05. The high belonging group mean was between 4.13 and 4.85. Table 7 breaks down the participants of each group.

Participants for the qualitative phase of the study were contacted via the contact information specified on the survey. All 16 participants in the low and high belonging groups and who were willing to participate were contacted. After being contacted via phone or email, only eight of the 16 participants responded to participate in the interviews. Students received a new information sheet that specified the purpose of the follow-up interviews (Appendix F). The researcher provided students with the information sheet prior to starting the interviews and allowed participants to ask questions prior to beginning. The information sheet served as consent for students' participation. A reminder email or text message was sent to the participants every two weeks during the recruitment window (Appendix G).

Table 7

Breakdown of Potential Qualitative Participants

	Low Belonging	**High Belonging**
	Mean range: 2.30 – 3.05	Mean range: 4.13 – 4.85
Total	18	11
Male	6	3
Female	10	8
Missing gender	2	0
Cohort member	7	5
Non-cohort	11	6
Willing to participate in follow-up	8	8
Male	0	1
Female	7	7
Missing gender	1	0
Cohort member	4	3
Non-cohort	4	5

Instruments.

Interview Protocol. The interview protocol was semi-structured and was adjusted based on the quantitative phase of the study. The same individuals who participated in the revision process of the quantitative measures evaluated the protocol and feedback was used to revise the protocol as needed. Minor changes, such as removing negative wording, were made to the interview protocol.

Tentative interview questions were created prior to the start of the study, however, once the quantitative phase was completed adjustments were made to finalize the protocol. The

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finalized protocol can be found in Appendix B. Additional questions were added to the protocol after the first phase of the study.

The protocol addressed the third and fourth research questions: "How do Black students describe their perceptions of belongingness at the university and in their STEM programs?" and "In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program?" The interview protocol was adapted from Zumbrunn et al. (2014) to specify the level of analysis (i.e., program instead of class). An example of a question from the protocol is: "Tell me about a time when you did not feel accepted or included in your program." This question also included a probe to draw more information from the participant, which was: "Why did you not feel included?"

One main question and a probe were added after the creation of the first iteration. The researcher added the last question to the protocol "If you could suggest something to the university administration to assist Black STEM students increase their sense of belonging, what would you suggest?" Additionally, a probe was added to understand how students' families were influential to their sense of belonging and success in the university. As described in the Research Design section, in explanatory sequential designs, the quantitative data collection and analysis is conducted and necessary adjustments were made to the qualitative phase, as needed. This process is illustrated in Figure 6. The revisions took place during the "Case Selection; Interview Protocol" phase of this design.

Data collection procedures. Qualitative data were collected via semi-structured interviews. Interviews took place with students in an agreed upon location. Of the eight interviews that were conducted, one interview was conducted via phone for convenience of the participant. The duration of interviews ranged from 17 minutes to 45 minutes. A digital

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recorder was used to record the interviews; students were made aware that the interviews would be recorded, transcribed, and discarded after transcription. Participants were allowed to choose a pseudonym that was associated with their gender at the start of the interview.

   Data analysis procedures. Once the interviews were conducted, the researcher transcribed the interviews and imported the data into a qualitative program, QSR NVivo, used for storing, coding, and analyzing. Prior to beginning the coding process, the researcher emailed each participant a copy of their transcripts for member checking. Participants were informed that they were able to add, change, or remove any portion of their dialogue if they saw fit. The researcher asked participants to return changes within seven days from the time they received the transcripts. Participants were informed that the absence of a response would indicate that the information was accurate and ready for analysis. A sample of the member checking email can be found in Appendix I.

   An in-depth read of the data after the interviews assisted the researcher in gaining a very general sense of the information that the participant had expressed; notes were also taken during this time but coding and theme building were saved for a later step in the qualitative phase (Creswell, 2009). Figure 6 displays a general sequence of how the qualitative data was analyzed. Although the steps are shown in sequential order for illustrative purposes, some of the steps were revisited throughout the analysis process. The steps are not always completed in this hierarchical order; instead, Creswell (2009) considers it to be an interactive process.
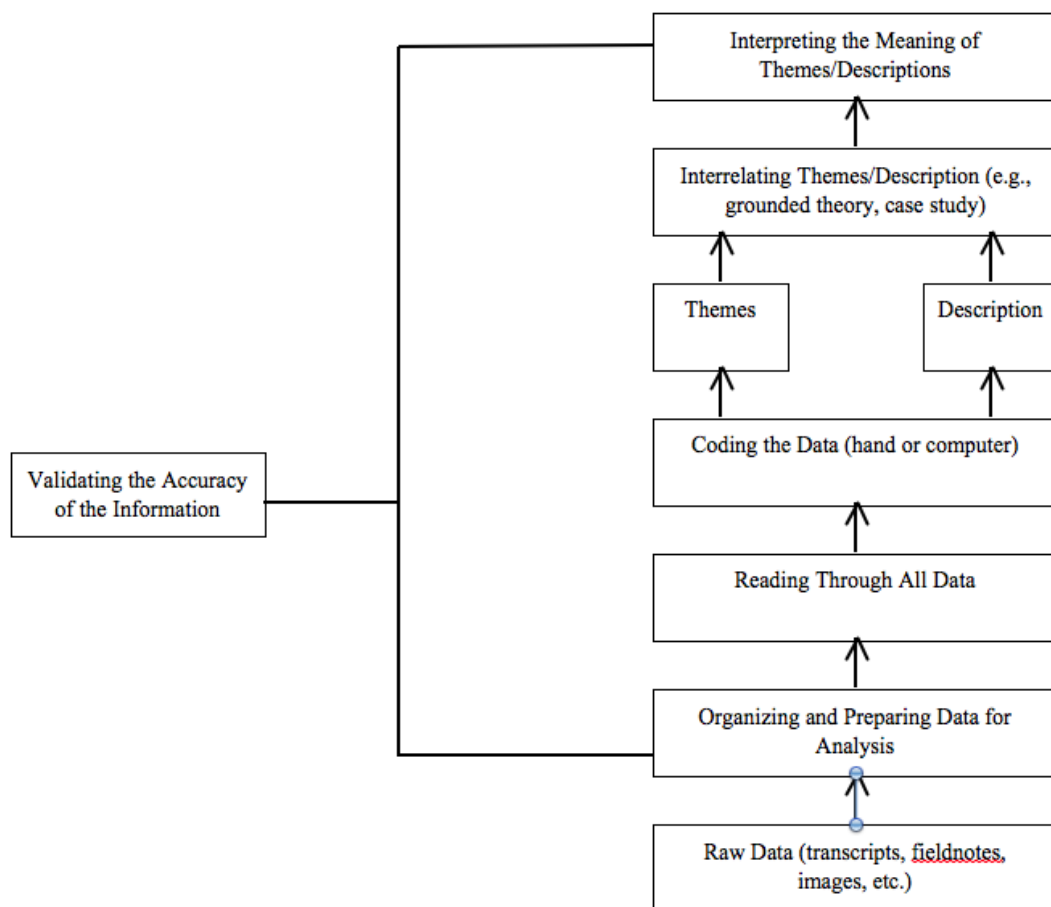
Figure 6. Data Analysis Sequence in Qualitative Research (Creswell, 2009).

The current study used a descriptive research design, the researcher sought to understand

the essence of belongingness of Black students in STEM programs. This methodology allowed

the researcher to observe, examine, and describe the lived experiences of participants, as it

pertained to their belongingness in the university and within their STEM majors. Coding and

gathering themes assisted the researcher in developing a general description of the phenomenon

being studied. Researchers utilizing a descriptive research approach seek to describe and

understand a phenomenon or construct using participant interviews (Groenewald, 2004). For this

reason, the goal was to use wording and phrasing directly pulled from student interviews as

codes and themes. These themes were then used to create a general description about all of the interviews. The entire process was guided by the qualitative research questions.

Coding was the next step in analyzing the student interviews. Coding is the process of organizing interviews into segments of text to assist in making meaning of the obtained information (Creswell, 2009). This process involves labeling or categorizing phrases or sentences from the interviews. The labels can be themes or key words that were used in the interviews; the codes were used to capture the essence of important phrases, sentences, or paragraphs.

Merriam (2009) suggested several steps for coding and analysis of qualitative data. In the process of category construction, the researcher gets a general sense of all the interviews and begins creating categories from each of them. She suggested that the researcher first start by reading through the interviews, the field notes that were taken during the interviews, and other memos or notes that accompanied the first interview.

The researcher utilized a common practice called directed content analysis (Hsieh & Shannon, 2005). In directed content analysis, existing research and theory guides the coding process and themes. The directed approach allowed the researcher to use key concepts as codes and themes while coding the raw data of an interview. The concepts outlined in Tinto's and Strayhorn's model were used as codes for the initial coding of participant interviews. When portions of the text did not align with portions of the theory, additional codes were added. During this time, open coding was utilized. This type of coding was expansive and included words or phrases that were used by the interviewee and concepts that were available in the literature. After the process was complete for one transcript, the researcher went back through and began to collapse the codes based on redundancy or similarities in the codes. The

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subsequent transcripts were coded in the same manner; however, the researcher kept in mind the previously determined codes and used them where appropriate. A master list of codes was the result of this coding-collapsing-merging process. The master list is comprised of the patterns and codes that were seen through the data and has significantly fewer categories than when the coding process first began, these constitute the themes. Themes are a direct reflection of the raw data and the codes that were derived from the data.

Trustworthiness. Trustworthiness or validity, as it would be referred to in quantitative research, can be established in a number of ways for qualitative data. Guba (1981) first discussed these concepts in reference to the naturalistic inquiry paradigm. The naturalistic inquiry paradigm can also be referred to as research using phenomenological approaches. Because this type of qualitative research cannot be validated in the positivist sense, the researcher utilized other methods to ensure trustworthiness of the data. The concepts presented by Guba (1981) and later expanded on by Shenton (2004) were (a) credibility; (b) transferability; (c) dependability; and (d) confirmability.

Credibility. Each term that is used to establish trustworthiness corresponds to a method of traditional validity. According to Lincoln and Guba (1985), the first factor, credibility, is the most important factor when establishing trustworthiness and corresponds to internal validity. To establish credibility for this study several steps were taken by the researcher. As suggested by Shenton (2004), one way of ensuring credibility is to be sure to only include participants that are "genuinely" willing to participate (p. 66). By ensuring this, participants will likely be more open and honest during the interviewing process. After interviewing, transcripts were sent to participants for member checking. This process provided participants a chance to read what was used in the research study and to assess the accuracy of the data; participants were able to

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change, withdraw, or add information during member checking. Member checking provided the opportunity for the participants to express what they may not have been able to during the interview.

The researcher also ensured frequent debriefing with the dissertation chair and/or committee. The debriefing sessions assisted the researcher in seeing other possible perspectives in the data. Additional experiences provide varying viewpoints. These sessions were also used as a time for the researcher to check interpretations, conflicts, ideas, and emerging themes. This process was very important for the current study. Due to the researchers' personal experience and position in the community as a Black student, debriefing assisted the researcher in bridling of thoughts and experiences. Bridling is associated with ensuring or restraining the researcher's prior experiences and understandings of beliefs, assumptions, thoughts, and feelings. Instead of the commonly used bracketing technique, the researcher makes known their feelings and beliefs of the phenomenon being studied, while keeping in mind how it may influence the interview process and the analysis. Having these debriefing sessions allowed the researcher to talk through any preconceived feelings that may be associated with the topic. Each one of these steps helped the researcher establish credibility for the study.

Transferability. Transferability is related to external validity of a study. Researchers have acknowledged that generalizability is difficult to achieve in qualitative research because each case is observed in context of the environment. Shenton (2004) suggests that to gain transferability in qualitative research, researchers should provide thick descriptions of the research study to allow future researchers and readers the ability, if they see fit, to transfer to other populations or studies. Some information that is included in Chapter Four to ensure sufficient contextual information are: (a) inclusion criteria; (b) exclusion criteria and

explanation; (c) detailed information of the setting; (d) number of participants; and (e) length of interview sessions. The study procedures may not be truly transferable but providing such information might assist other researchers in transferring these procedures and results if they choose.

   Dependability. Dependability addresses the issue of reliability. As described earlier, a qualitative study can be repeated but is unique because it has its own context. Dependability attempts to provide information for readers and future researchers if they intend on repeating the study's procedures, methods, with similar participants, to obtain similar results. When this is not possible, the researcher provides detailed information about the methods and procedures of the study (Shenton, 2004). For the current study, the researcher included necessary information that is pertinent for repeatability. Information that is addressed to establish dependability include: (a) description of the research design and implementation of the study; (b) details of the interviewing process; and (c) taking notes of the qualitative analysis.

   Confirmability. The factor of confirmability is concerned with the researcher being objective in the process and analysis. To establish confirmability, it is important that the experiences and perceptions of the participant are expressed over that of the researcher. As described earlier, bridling is a technique that was helpful in this study because of the close connection that the researcher has to the study. Miles and Huberman (1994) noted that to establish confirmability it is important for researchers to address their biases to the topic. This was addressed during analysis of the qualitative phase to ensure that the researcher is not interpreting something that may not be there, or overlooking something that may be important to the study. Perceptions, beliefs, experiences, and even reasoning for choosing specific

methodology should be addressed to ensure confirmability; providing detailed information that addresses each aspect will assist in doing so (Shenton, 2004).

Mixed Methods Data Analysis

As explained previously, the design of this study relied heavily on the quantitative results to establish and refine the qualitative phase. Creswell and Plano Clark (2011) suggested a number of strategies for analyzing mixed method data, one of which is the extreme case analysis. Extreme case analysis is used when the researcher is interested in learning more about the participants with extreme or unexpected results on the PSSM. Those cases were then examined using the data from the follow-up phase. In the current study, the student interviews were used to assist the researcher in explaining these cases. The mixed methods phase of analysis was used to answer the fifth research question: "How do the experiences of Black STEM students support or contradict the results of students' perceived sense of belonging scale scores?"

The goal of the current study was to draw on the meta-inferences by using the qualitative data to provide richer understanding of the results from the quantitative phase. To accomplish this, the researcher used a strategy referred to as side-by-side comparison (Creswell & Plano Clark, 2011). A side-by-side comparison is not only a tool to organize data from both the quantitative and qualitative phases, but it is also used to merge the data and show how responses from student interviews explain, confirm, or disconfirm the results of the PSSM survey. The side-by-side comparison (see Chapter Four) will begin with the results from the quantitative phase and will be followed by specific quotes from the qualitative phase.

Institutional Review Board Considerations

Approval was obtained from the university Institutional Review Board (IRB; ID# HM20006681). The researcher filed for exempt review status due to the nature of the proposed study; the current study involved no more than greater than minimal risk to the study participants. All guidelines set up by the IRB were followed throughout the study.

Delimitations

Due to the researchers' personal interests and to ensure manageability of the study, the researcher chose to delimit the study to Black students. Including multiple races of students would take away from the direct purpose of this study - to understand sense of belonging of Black students. Additionally, the researcher was only interested in a subset of these students. Students in science, technology, engineering, and math majors were identified as the target sample because of the increased importance of these majors and careers paired with the decreased number of Black students being successful in these fields. A large, urban predominantly White institution was used as the setting for this study because of the convenience. Utilizing additional institutions would be outside the parameters of the study and could potentially make the current study unmanageable.

The researcher also delimited the study to a mixed methods design because of the need to gain more information from students. Although quantitative design would give the researcher very narrow results, the scores on the PSSM measure are very important. A mixed methods design allowed the researcher to obtain scores for each individual student through the use of the quantitative measure, while the qualitative phase allowed the research to dig deeper into the essence of the construct of belongingness.

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Chapter IV: Findings

The purpose of the current study was to examine Black STEM students' sense of belonging and to determine whether belongingness played a role in students' academic achievement. There were five specific research questions that guided the research study; questions one and two guided the quantitative portion of the study, research questions three and four guided the follow-up qualitative portion of the study, and the fifth and final research question guided the mixed methods research question. They are as follows:

R1: Is there a significant difference in sense of belonging between Black STEM students who participate in cohort-supported programs and those who do not participate in these programs?

R2: Can student self-reported college GPA be associated with age, gender, major, and scores on the adapted Psychological Sense of School Membership scale?

R3: How do Black students describe their perceptions of belongingness at the university and in their STEM programs?

R4: In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program?

R5: How do the experiences of Black STEM students support or contradict the results of students' perceived sense of belonging scale scores?

Using an explanatory sequential mixed methods approach, both the quantitative and qualitative data were collected and analyzed separately. To reiterate, the quantitative data were collected using the PSSM scale during the first phase. The qualitative interview questions were

then revised from its original iteration based on the quantitative results to ensure that questioning would reflect information that would provide a more in-depth look into the quantitative results. The qualitative phase was then conducted and data were analyzed. Data from both phases were then analyzed together to make up the mixed methods analysis. The following chapter will present the findings from each of the three phases.

Quantitative Results

Preliminary analysis. Prior to beginning the quantitative analysis of the data, the researcher examined the data for missingness and extreme outliers to determine whether there were any data points that needed to be excluded. One hundred and twenty-four students began taking the online survey; due to missingness, several cases were deleted prior to the analysis. As discussed in Chapter Three, ten participants started the survey but did not complete more than half of the survey; 21 were excluded because they did not meet the initial criteria, which was to be between the age of 18 and 24, be a full-time undergraduate students, be a declared STEM major, and identify as Black or African American; and an additional four students completed the survey but were not included in analyses because their declared major was not considered to be in the STEM field for the scope of this study. Three of those students chose psychology and one was a psychology/sociology major. With these exclusions, there were 89 completed survey responses.

Prior to beginning the analyses, the researcher computed a new variable to signify the two-component structure that was found when conducting the PCA, outlined in Chapter Three. The researcher used each item from each of the components to create new variables, naming them based on the characteristics of the item. Component one was called Interactions and

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component two was referred to as Welcoming/Belonging. The newly computed variables were used in subsequent analyses.

Data screening. As discussed in Chapter Three, several assumptions were tested for prior to the start of subsequent analysis. All assumptions for each of analysis were tested prior to being run in SPSS, which were also addressed earlier in Chapter Three.

Research question one. To answer the first research question, is there a significant difference in sense of belonging between Black STEM students who participate in cohort-supported programs and those who do not participate in these programs, an independent *t*-test was conducted to measure whether there was a relationship associated with being a member of a cohort program or not and a student's total sense of belonging score. The dependent variable for this analysis was the two-components of PSSM scale, Interactions and Welcoming/Belonging. Cohort membership was used as the grouping variable or the independent variable.

On average, participants who were not affiliated with a cohort program, such as a living-learning community or summer-bridge program, did not show a greater sense of belonging on either the Interactions ($M = 3.79$, $SE = .64$) or Welcoming/Belonging ($M = 3.35$, $SE = .66$) subscales as compared to their peers who had gone through such program (Interactions, $M = 3.73$, $SE = .73$; Welcoming/Belonging, $M = 3.54$, $SE = .77$). The difference in means found between these groups were not significant for either the Interactions (t (85) = .37) or for the Welcoming/Belonging (t (85) = -1.17) subscale.

Research question two. The second research question, can student self-reported GPA be associated with age, gender, major and scores on the adapted Psychological Sense of School Membership scale, was answered by conducting a multiple regression analysis using SPSS software.

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A multiple regression analysis was used to determine whether several of the demographic variables, along with participants' sense of belonging subscale scores, predicted students' self-reported college grade point average (GPA). The independent variables examined in this analysis were students' PSSM subscale scores (Welcoming and Interaction), age, gender, high school self-reported GPA, academic standing, academic major, and number of Black faculty members in the department. These variables were included in the analysis of the current study because of their usage in previous studies (Freeman, Anderman, & Jensen, 2007; Strayhorn, 2015; Zumbrunn, McKim, Buhs, & Hawley, 2014). These variables were found to statistically significantly predict college GPA ($R^2 = .38$, $F(8,72) = 5.52$, $p < .001$). Although this was true for all of the variable,s when examining them as a whole, several of the variables were not found to be significantly different from zero. The only variable that was found to be significant predictor of college GPA was age, $p = .000$, while academic standing approached significance, $p = .06$. Table 8 illustrates a summary of the multiple regression analysis.

Table 8

Summary of Multiple Regression Analysis

Predictor Variable	*b*	*SE b*	B	*p*
Constant	9.52	1.72		.000*
Welcoming Score	.05	.13	.05	.682
Interaction Score	.14	.13	.12	.295
Age	-.39	.08	-.74	.000*
Gender	-.23	.17	-.13	.19
High School GPA	.23	.15	.16	.12
Academic Standing	.20	.11	.29	.06
Major	.02	.02	.10	.35
Department Faculty	.03	.11	.03	.77

* denotes a *p*-value that is significant a *p* < .001

Qualitative Results

Preliminary analysis. After the quantitative data were collected and analyzed, potential participants were selected and contacted for the qualitative portion of the study, as stated in

Chapter Three. Sixteen students were contacted as possible participants for this phase. As stated earlier, the researcher's goal was to recruit a mixture of students who represented differing levels of belongingness as well as students who had participated in cohort-supported program and those who had not. The research included this phase as a follow-up to the results of the students' PSSM scores. This phase was necessary because the researcher was interested in obtaining information that could explain the scores that students received on the survey. The additional phase allowed the researcher to probe students on the experiences they thought were the most impactful to their sense of belonging.

The final breakdown of the participants included eight students, four in the low belonging group, and four in the high belonging group. As well, for each of the belonging groups, there were two students who had participated in a cohort-supported program and two that had not, Table 9 further illustrates how students were purposively selected for the second phase of the study.

Table 9

Breakdown of Participant Categories

	Low Belonging	High Belonging
Cohort	2 students	2 students
Non-Cohort	2 students	2 students

Participants. Table 10 displays the final breakdown of participants who responded and were willing to participate in the follow-up interview. The researcher did not provide additional demographics in the table 10 because of the low cell count for many of the majors represented in the sample. Providing the students' GPA and/or age could potentially identify the student, for this reason only demographic information that the researcher believed would maintain the anonymity and confidentiality of the student was included in the results. Table 10 demonstrates

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how the qualitative participants represented a mix of students from across majors and academic
standings.

Table 10

Breakdown of Final Qualitative Participants

Pseudonym and belonging group	PSSM Score	Gender	Major	Academic Standing	Cohort?	Program
"Kristina" (low belonging)	2.40	Female	Clinical lab sciences	Second-semester freshman	Yes	Advancement
"Kierra" (low belonging)	2.65	Female	Biomedical engineering	Second-semester freshman	Yes	Advancement
"Bre" (low belonging)	2.70	Female	Exercise science	Junior	No	
"Selena" (low belonging)	3.00	Female	Biology	Junior	No	
"Mary" (high belonging)	4.15	Female	Forensic science	Senior	No	
"Jason" (high belonging)	4.15	Male	Biochemistry	Second-semester freshman	No	
"Star" (high belonging)	4.30	Female	Biology	Sophomore	Yes	Strive
"Brenda" (high belonging)	4.45	Female	Biology	Second-semester freshman	Yes	LSAMP

As suggested by Saldaña (2013), the coding process and analysis was completed in two
steps or cycles. After completing the first round of coding, which yielded 40 codes and nine
subcodes, the researcher went back to examine which codes appeared to be redundant, which
codes were not used at all, and which codes were only used in maybe one or two of the

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interviews. Upon doing so, the researcher found several related codes that could be collapsed into broader codes, as well as codes that could be deleted from the codebook. During the process, the researcher decided whether the codes that were used the least should remain or should be included under another code. Some codes that were only used once or twice were retained because of its importance to the text (Miles, Huberman, & Saldaña, 2014; Saldaña, 2016). Using NVivo software, the researcher examined whether the codes were used in each of the transcripts and how often they were used across the project. These codes were transformed or condensed into patterns/themes that related to one another. As suggested by Creswell (2013), these codes were pared down to several larger themes that encompassed the general meaning of the codes. Using an axial coding method, the researcher chunked the smaller, more fractured pieces of coded text into categories that link the codes with some relation amongst them (Saldaña, 2016).

The following sections are organized by research question as well as broader themes/categories. There is some overlap between each of the research questions; however, the researcher felt like much of what participants' expressed during their interviews was applicable to both research questions. Over the 39 final codes and subcodes that were established through the process suggested by several qualitative researchers (Miles et al., 2014; Saldaña, 2016), six themes were created: student perceptions of the university; student perceptions of their STEM major; individual attributes; family; faculty/staff interaction and support; and peer interaction and support.

Tables 11 through 16 show exemplar quotes related to each theme. The researcher did not directly ask participants whether they felt supported by their family, peers, or faculty and staff. Each of the tables contains participants' PSSM score, for reference and for comparison,

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and an exemplar quote of what was expressed by each of the students as it relates to students'
perceptions of belongingness. The exemplar quotes were chosen to illustrate and represent the
theme of the interview. Many of the quotes were indicative of the level of perceived
belongingness of the participant. Some quotes confirmed students' scores on the Psychological
Sense of School Membership (PSSM) scale, while other quotes disconfirmed these scores. With
the amount of data provided from the qualitative phase, only the exemplars could be displayed.
A table is included after each section to further illustrate what was expressed by participants.

　　　　Research question three. The third research question of this study was, how do Black
students describe their perceptions of belongingness at the university and in their STEM
programs? An integral part of this research was to understand how students felt, what they
believed, and what they perceived about the university and their STEM majors as it pertained to
their sense of belonging as Black students within the university.

　　　　Theme 1 – Student perceptions of the university. Students across the groups talked a
great deal about the aspects of the university that they did not like, what they did like, and
discussed the changes they wanted to see made across the university and within their respective
majors. Within this theme, several codes are included that pertain specifically to the university:
university support; issues within the university; diversity; culture; and recommendations. There
was a broad range of feelings across the participants, many echoing the same sentiments.
However, when students were asked specifically to rate their sense of belonging in the university
they mostly rated themselves pretty high. None of the participants rated the belongingness, on a
scale of one to ten, as being anything below six. Even those students in the low belonging group
reported fairly high belonging ratings.

One of the primary focuses of this was study was to understand whether students who had participated in cohort programs had different experiences and perceptions of the university and major/program. The quantitative results showed there was not much difference between the two groups, the same was true for the qualitative portion of the students. Specifically, the first theme seemed to show varying opinions of the university between those in the cohort and those not, as well as those in the low and the high belonging groups. Students that had been in the cohort program had mostly positive experiences in the university, which was also expressed by the rating that they gave when asked to rate their experiences in the university. Of the four students in the cohort group, three of those students spoke positively about their experiences in the university. Kristina, the student with the lowest belonging score, gave her university belonging a six. This was an interesting finding, as many of the students, in both low and high belonging groups, rated their belongingness in STEM much lower.

There were some students in the low belonging group who shared very positive experiences within the university and their major, while students in the high belonging group also shared their disappointments with the university. However, there were trends in the data that may have helped explain the differences. For instance, all students ($n = 4$) in the high belonging group spoke highly of their perceptions of the university. While this is true, only half of the low belonging group members shared positive comments regarding their perceptions of the university.

Several participants expressed their gratitude to the university and believed that the university was attempting to express to students that they are welcomed and included. Bre directly mentioned one student organizations saying, "I just feel like they really do cater to us and I feel like they do everything they can do to make sure that we feel like this is our

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community…" when referring to the Office of Multicultural Student Affairs. Mary mentioned how she appreciated that the university was taking steps to appreciate and celebrate Black students, "I believe this year was the first year that they had a graduation for Black students separate and I was happy to hear that…" in reference to the special kente celebration held for Black graduating students. Although this is true, several students also brought to light their disappointment in the recognition of racial issues, the lack of diversity among students and faculty, and the lack of organizations that represent black students. Bre voiced her appreciation for the support of the Office of Multicultural Student Affairs, she also expressed her disappointment in the lack of diversity, "…y'all claim this diversity but you guys really aren't stepping up to the plate…it was just kind of disheartening…they claim to be the most diverse university on the east coast, where? How? Where?" Mary also expressed her frustration with the university addressing issues at hand, "I feel like it was a lot of student-driven things that happened and it wasn't really initiated by maybe the staff here, which is probably something I wish I would have seen."

All but one participant, Jason, discussed the lack of diversity among the faculty and staff at the university. Kierra expressed her disappointment with the university, while they brand diversity, she felt as though "they're pretty contradictory, because despite it being very diverse in the student population, it's not diverse in the actual faculty." Brenda discussed how she thought having an African American advisor could be beneficial, "I do see how somebody that is African American, I can relate to a little more, because I do feel like sometimes the things that I say do go over her head [her advisor who is White]." Star discussed that she has not taken classes with or seen Black faculty members in her department during her time at the university. She felt like having a Black faculty member could make you "feel like you're represented in more than one

way." All participants noted that there were very few, if any, Black professors in the university and within their majors, however, they also noted that even though this was something they desired they still appreciated their non-Black faculty and staff members. Mary noted that she "wouldn't wanna [*sic*] downplay any of my White professors because all of them have been pretty great especially in my forensic curriculum specifically. They all have a passion for the field they made me realize more of what I wanted to do." Kristina also noted that in her experience she has "had really nice teachers, who were really inclusive." This shows that although students were concerned with the lack of Black professors on campus, they still believe that the support and inclusiveness of all professors is what is essential to their success, no matter their race.

Two participants expressed how shocked they were to arrive and not see the diversity that the university publicly professes. Brenda, a member of the high belonging group, stated, "When I first got here I was actually shocked that [there] was as many white people that there are… I guess when I first got here I was expecting a huge, like a massive amount, of diversity…" Bre, a part of the low belonging group, called what she saw "cosmetic diversity," explaining that she only feels as if the university looks for people to take pictures of of students of color for brochures and the website to portray diversity. Another low belonging student, Kristina shared the same sentiments, "My experiences as a Black student…honestly from day one, like, what is it…from day one, starting with welcome week, I was kind of looking for, I guess, Black [organizations] at [LUU] and they were kind of really hard to find… it was kind of disappointing to not see that representation or unity with [LUU]." Although the general sense of the participants seemed to be disappointment, several students expressed their gratitude for other ethnicities, cultures, and religions. One student, Selena, who had a lower sense of belonging,

noted, "I enjoy the diversity that we have on our campus and it does make me feel very comfortable to go here rather than go to like [other state university] or like [other state university] or something like that." Brenda also admitted that although she expected to see more Black students she saw "a lot of Asians, a lot Indians, Whites…" Despite the disappointment and frustrations expressed, Star, a participant in the high belonging group, acknowledged,

> I came [to LUU] because I knew it was very diverse so I knew I wouldn't feel left out. Going to other colleges and like touring before I came here, I knew the ratio as a Black female was a little off at other universities so I felt like I wouldn't have a group where I would belong, but here at [LUU] you can look around and see there are a lot of Black students here.

As can be seen from the quotes shared by the student participants, there were mixed feelings regarding the diversity on campus.

About half of the students, a mixture of both the high and low belonging group, talked about the university culture, which was mostly positive. However, many participants referred to the community of Black students at the university. Selena mentioned that her experience as a Black student in the university had been good so far, attributing it to

> Hav[ing] a strong 'wokeness,' we're a very liberal school so I've never really stayed around people that made me feel uncomfortable for my race so it was easy for me to find people who celebrated blackness and celebrated who they were and different cultures and POCness.

Wokeness is a popular culture term referring to the awareness, of mostly Black people, to community and world injustices and issues. POCness refers to person of color, which is often shortened to POC. In this statement, Selena acknowledged the university's liberalism and

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accepting nature of those of color and more specifically, Black people. Bre also acknowledged that the community of Black students, albeit small, was strong, "I feel like the Black community here although it is very small, it is definitely more tight knit...I feel as though there's so little of us, we do try to stick together…" Although, not everyone agreed that the culture on campus was always positive. Two participants, one in the low and the other in the high belonging group, talked about the segregation among and between Black students and other races. Kierra noted "[The black community is] kind of like dispersed, I don't know. They come together occasionally sometimes for certain things, for certain events, I definitely feel like Black [LUU] presence can be stronger." However, she then noted "I really felt their presence during Black History Month." Mary also expressed her concern for the segregation of students. Being on the homecoming committee, she frequently discussed her goal of bringing more students of differing ethnicities together to celebrate the university,

> With [LUU] branding diversity and with it still being segregated, it's hard to [bring everyone together for homecoming]. We tried our best and if we saw a good mixture [of ethnicities] at an event it made us even happier because we all know we put forth the effort to make that happen.

Mary also spoke very highly of the culture of staff at the university. She was the only participant that specifically named individuals who she thought contributed to the campus environment and culture. She later discussed her comfortability due to the culture of the campus, stating

> Just the atmosphere here at [LUU], like in Starbucks, there's a lot of Black female workers that work there…just seeing them, them having a positive attitude saying how ya doing, good morning, how are you, have a good day, ya know it's like oh it's another day at [LUU] when you come in contact with them, it's cool. I would say the general

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community, I would say I had more, more comfortability, not comfortability but reassurance when I have someone who is Black but either way whether they're Black or not just having them there still had an impact on my enjoyment here at [LUU].

Table 11

Comparison of Data from PSSM Survey and Student Interviews – Theme 1: Perceptions of the university ($n = 8$)

Participant	PSSM Score	Exemplar quotes
Kristina	2.40	"I would say in between because it wasn't good or bad but I feel like I would want it to be a lot better especially for incoming Black student. If I could get on an e-board of one of the orgs, I would try to have a lot more of a presence at [LUU] to help other Black students feel welcomed"
Kierra	2.65	"I think [LUU] does a lot effort to try to ensure the students are comfortable, ya know. I think they're pretty contradictory, because despite it being very diverse in the student population, it's not diverse in the actual faculty."
Bre	2.70	"I really do enjoy [LUU]. [LUU], just like every other predominantly white institution, don't get me wrong but, I feel safer here."
Selena	3.00	"So far at [LUU] it's been really good actually, as a black student, because we have a strong "wokeness" we're a very liberal school so I've never really stayed around people that made me feel uncomfortable for my race so it was easy for me to find people who celebrated blackness and celebrated who they were and different cultures and POCness."
Jason	4.15	"So I think I have had an overall good experience when it comes down to just my race. But I mean, I have like felt a little disconnected but not because I'm black but maybe because I am a guy, or maybe because how I look like, maybe like my physical attributes…"
Mary	4.15	"I pretty much enjoy the diversity and the different backgrounds that I saw here on campus. It made me happy to be here but yeah."
Star	4.30	"I came here because I knew it was very diverse so I knew I wouldn't feel left out."
Brenda	4.45	"When I first got here I was actually shocked that it was as many white people that there are, I know that sounds bad but I was shocked, because I didn't think, I thought that, I mean I guess when I first got here I was expecting a huge, like a massive amount of diversity and then I got more used to and there actually is a lot of diversity here."

Theme 2 - Student Perceptions of STEM Major. A prominent topic of discussion during the interviews was the perceptions of belongingness of students in their STEM program/major. Participants talked in depth about their feelings toward the STEM majors and their relationships with peers and faculty within their programs. Although there was a generally high sense of belongingness among students and across all groups when discussing their perceptions of belonging in the university, the contrast was significantly different when they discussed their perceptions within their programs among all students, across all groups.

The sentiment of the participants was similar and the majority of them shared the same concern – the need for an increase of Black faculty members in the university and in STEM programs. However, when delving deeper into the data, several trends emerged, which were surprising. Similar to theme one, there appeared to be some difference in perceptions within in STEM between those in a cohort program and those who were not, differences that were not expected. The students in the cohort often had more negative experiences and expressed fewer positive perceptions than the students who had not participated in a similar program. This finding is interesting, as several programs that these students participated in are focused on helping students to become more comfortable in their STEM majors. Students who have not or were not in a living learning or summer enhancement programs seemed to have better perceptions of their majors.

As well, the majority of students in the high belonging group had positive and supportive relationships within their major, although there were some outliers. For instance, Bre, a member of the low belonging group, spoke very highly of her time in her STEM program, while Brenda, a member of the high belonging group, expressed her frustrations with STEM and her major. However, generally, the students in the low belonging group mostly had a negative reaction to

the STEM majors. These differences could have been fundamental to students' perceptions of belonging.

While most participants rated their belongingness at the university somewhere between six and ten, most participants rated their sense of belonging in their STEM majors between two and nine on the same one to ten scale. Star chose nine as her sense of belonging in her STEM major, chose ten for her belongingness in the university and only subtracted a point because she did not feel as acclimated or included in her STEM major due to her minority status.

Most discussion with students regarding their belongingness in their STEM majors referred to their minority status and the lack of Black faculty and staff. All participants shared the same thoughts regarding their concern surrounding the lack of diversity. Brenda noted, "it's just not as many people that look like me…you know how just when you're the same race as someone, you can understand more what that person and you can talk to them more…" Star, the student with the highest belongingness score based on the PSSM survey, also admitted, "there aren't many Black students in STEM," which was the reason she provided for her decreased belongingness score within her major. Other participants also noted their desire to have additional faculty that were Black and believed that "everybody should have professors that [are] relatable or looks like them, of some regard." Mary, who was a graduating senior, noted that "[she didn't] believe [she] had any black professors in any of [her] core curriculum, like science classes or forensic science classes."

Table 12

Comparison of Data from PSSM Survey and Student Interviews – Theme 2: Perceptions of STEM Major (n = 8)

Participant	PSSM Score	Exemplar quotes
Kristina	2.40	"I feel like when it comes to, sometimes when it comes to picking group work, you know how you have to pick partners in lab, I feel like kinda like people kinda stick to their own race and if I'm with people in a different race sometimes I feel like they may assume they are smarter than me because I'm Black."
Kierra	2.65	"I feel like it's not enough Black, or strong black organizations for other STEM majors."
Bre	2.70	"…it's really not that many of us [Black students], and the thing is, within, with the Black women I've spoken to in my major, within our programs, we don't really talk that much I mean in, unless it's like school related."
Selena	3.00	"That's a little different because a lot of people who are in the liberal areas are in liberal studies rather than of STEM studies. It was hard, honestly, because like I don't really have a group of close knit friends who are in the STEM studies as I am…"
Jason	4.15	"…there's been other African Americans in my class, it's been a very diverse group of individuals in my class, and I've felt an overwhelming, felt in [sic] being accepted both by the students and students in the class and by my teachers."
Mary	4.15	"…as I said before there is primarily little to not a lot of black students in my field, in the science field at all, its majority white or some other ethnicity, Indian or, it's not really a lot of black people… it didn't make me uncomfortable because like I said before I'm used to diversity, I like different cultures and different people…"
Star	4.30	"In the STEM at [LUU] but you can definitely see that there are some [Black students] and then there are definitely organizations for those of us [Black students] who are in it that try to make opportunities for us, so yeah."
Brenda	4.45	"I think that is where it then becomes different, like it's very visible that it's not a lot of black people in like my bio classes or in my lab, I think I was, I think there were 2 black people in my lab...and he was a guy."

Research question four. This next section addresses research question four: In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program? The purpose of this research question was to understand the factors students attributed to their sense of belonging or the lack of. Four themes emerged throughout the analysis process: Individual Attributes; Family; Peer Interactions and Support; and Faculty Interactions and Support. These themes provided rich data to explain how participants believed their belongingness had been enhanced or hindered.

Theme 3 – Individual attributes. Including this theme separately from the rest was important. Initially, there did not seem to be any differences among students in cohorts and those not, but taking a deeper look at the data, once again, some trends were extrapolated. However, more participants in the high belonging discussed their individual attributes. Additionally, all participants, although not always positive, in the non-cohort group discussed the role that their individual characteristics played in their sense of belonging. Many students who discussed their individual characteristics attributed how they were raised or the type or person they were to how they reacted to and experienced different situations. Some students organically discussed their attributes and characteristics as it pertained to their experiences; there was no probe associated. Because of that, many students did not talk about how their personalities played a part in their university experiences and sense of belonging.

Although this is true, those who did discuss such factors were more likely to be in the high belonging group (3 out of 4) than the low belonging group (2 out of 4), and more likely to not have been in a cohort. Additionally, those in the high belonging group spoke generally higher about themselves than those in the low belonging group. Two out of three in the high belonging group who spoke about their individual attributes as it pertained to their belongingness

spoke positively about their attributes, while one of the two did the same in the low belonging group. The students in the cohort group were more likely to not discuss their individual characteristics as a factor to how they have dealt with challenges on campus.

Jason, the only male participant of the study, talked a lot about avoiding certain groups of people who appeared to be racist, he said,

> I am a very inclusive, like just good person, like I would say that I am most of the time that I am. And so overall I don't allow, if people are around me I wouldn't allow them to act [discriminatory].

He also discussed that within the year that he has attended the university, he has purposefully excluded himself from activities and friends because of discrimination that he was intolerant to. Jason was not the only one who talked about avoiding situations or people. Brenda also noted that it was a "personal thing" to feel excluded, referring to her own agency of excluding herself from certain groups. Aside from the comments regarding negative situations, some participants noted their positivity as being a factor into their success. Mary stated,

> It probably all came from me being who I am and coming from the background that I come from and just and always seeing the bright side of things and always appreciating diversity so I came in with an open mind no matter what.

Mary's sentiments seemed to allude to the reasons why she was able to remain at the university and in her major, while many of her other friends either changed major or went to or wished they had gone to an Historically Black College or University (HBCU).

When discussing peer relationships with Selena, she expressed that over the three years that she had been attending the university that she was unable to find a close group of friends to study with. When probed about the reasons for this, Selena identified herself as the potential

problem saying, "[it] may be a personal issue…it may just be me being me…being too shy to step out. Or too shy to be like, 'hey guys, let's all study together,' or feeling a weird barrier of closeness."

Individual attributes, whether they are of a person who looks on the bright side of things or of a person who identifies as being shy, have a great influence on students' sense of belonging and interactions within the university. Speaking positively of oneself may signal a great sense of belonging of students.

Table 13

Comparison of Data from PSSM Survey and Student Interviews – Theme 3: Individual attributes (*n* = 5)

Participant	PSSM Score	Exemplar quotes
Kristina	2.40	"I chose [Advancement] because I felt like I was disadvantaged in high school I didn't have the same opportunities as other people to be ready for medical school so I was like maybe this will like help to put me ahead…"
Bre	2.70	"…when I went back I was just reverse culture shock because where I lived in northern Virginia my high school was so blended, I had never seen or met people from so many different countries, so many religions, ethnicities, I had never seen that. So to go from that, where everyone was so accepting so it was more than just your black or your white, to go to you're Black or you're White and clearly you're Black, clearly we don't want you here. I just never had to deal with that, I never really had to understand that. I was very ignorant to it…"
Selena	3.00	"I feel like that may be a personal issue with myself, it may just be me being me, and being too shy to step out."
Jason	4.15	"It's not that I don't really feel left out because I, I've always been in a mostly White environment. I grew up in schools that are mostly white. I've learned to have a balance…"
Mary	4.15	"I'm a pretty much positive person, I accept other people that may not be the same thing on the other side…"

Theme 4 – Family. Family was discussed among several participants, though not by all. A few talked about their family backgrounds, while others discussed the support they have received from family members. Students that spoke of parental support discussed the importance of their involvement to their success and belongingness. Parental support appeared to be very important to the students who discussed them. One particular student, Brenda, whom was the one student in the high belonging group who did not share positive experiences about her family, discussed after the interview how she hoped for an increase in support among her family.

Additionally, Brenda talked about her family, regarding their level of support, throughout the interview. She expressed her varying levels of support from each of her parents and how they have played a part in her experience at the university. Brenda started by saying, "My mom is really supportive. Me and my dad don't talk about school as much as we used to because he expects too much from me." She continued by discussing how she has struggled to live up to expectations of her parents since high school and has felt pressured by her family to do well in school. She spoke about her relationship with her mother, but also noted that she does not feel as if her mother understands what she is going through because she, herself, did not go to college. Brenda said,

> My mom is always like, 'you can do it, I know you can do it, you got it.' And whenever I'm like, 'no, I can't'…because [I'm] like, 'what if I can't do it, if I can't do it, I really can't do it,' she was like 'no you need to do it'. I guess because I'm the first one to go to college, like my grandma didn't go, grandpa, my uncle, my mom, none of them have gone. [My mom] really wants me to do really well, and I understand, but she puts a lot of pressure on me.

Students in the cohort group were less likely to discuss their families in a positive manner as compared to the non-cohort group. There were three students in the cohort group who talked about their family's background or as a support system and of the three, only one had a positive experience. Although only two students in the non-cohort group ($n = 2$) discussed family support during the interview, those who did all shared positive experiences and felt supported by their families. Brenda also expressed that her dad graduated college, but was not a STEM major and she felt as though, "I couldn't go to him for help, because you know how like it would have been a couple years since they went and they may not remember but she wouldn't understand how hard it is." She admitted that she felt like her friends with parents who attended and graduated from college might have a different experience.

The other participants who talked about their families believed that they were very supportive in their endeavors to finish college. Despite being busy completing her degree, Mary shared, "My parents, too [referring to supportive networks] ... I'm not really good with communication… I get so busy with school…but I knew through it all they were always there for me, if I needed." Jason also discussed the influence of his parents on his outlook on attending college and spoke about how he was raised in an African American family, which influenced him to "act in a certain way" in regards to how he thinks about diversity.

The participants who discussed their families seemed to attribute much of their individual characteristics to their family background and support. These students also were more likely to be in the high belonging group. Only one student, Kierra, in the low belonging group discussed family and the role they played on her college experience and belonging. The one student, Brenda, that spoke about their family seemed to have a negative experience with the support that she had received. All students in the high belonging group discussed their families in the

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interviews and the majority (75%) spoke about very positive experiences with their family and

the support that they had received while in school.

Table 14

Comparison of Data from PSSM Survey and Student Interviews – Theme 4: Family (n = 5)

Participant	PSSM Score	Exemplar quotes
Kierra	2.65	"…my parents didn't complete or didn't attend college."
Jason	4.15	"…my parents are African American that's the way they raised me that's the way they told me to talk, and act in a certain way.
Mary	4.15	"…I don't communicate with my parents as much but I knew through it all they were always there for me if I needed. But the text from them saying hey how ya doing, how are you, just checking kind of kept me leveled too because even I forgot to contact them they would always contact me to check on me and be like hey what are you doing are you alive, yeah I'm alive, I'm sorry."
Star	4.30	"They're really good. They really support me and being out of state, I pay a lot more but my family they, they literally take out a million loans just to make sure I can come here, get my education, they don't really care about the loans, as long as I can get what I need to get done…"
Brenda	4.45	"I think my family is really supportive, as supportive as they can be because no one immediate family on my moms' side has gone to college. And then my dad, they have but they didn't know biology so they don't understand, they know it's hard that's why they didn't do it, but that's it. That's why they're always like 'you got it, you can do it,' that's so annoying to hear, because what if I can't. I feel like they have this high expectation like we know you can do it, I'm like 'I'm trying!'"

Theme 5 – Faculty interactions and support. Students in the high belonging group were more likely to express appreciation of support of the faculty and staff at the university, while students in the non-cohort group generally communicated more disappointment. All students, except for Jason, focused heavily on the lack of diversity within the university and in their majors as issues impeding interaction and support. Students in the high belonging group were more likely to have more frequent interactions with faculty than the low belonging group. For the most part, students in the low belonging group expressed that they just looked at professors as teachers and did not see a reason to interact outside the classroom. This notion was completely different for those in the high belonging group who consistently talked about the need to get to know the professor outside of the classroom.

All participants, across groups, at some point in their interviews, talked about their interactions with faculty and staff members across the university and within their majors. Most interactions referenced seemed to be positive experiences. Bre noted that she thought the faculty cared about her a lot, especially her advisor who had worked diligently to ensure that she graduated on time. However, she also discussed experiences that were not so positive. She explained that her general advisor was not as supportive as her academic advisor within her major. Bre was a transfer student, and discussed how she was surprised to be so supported at a predominantly White institution due to her past negative experiences with advising at a different institution. Star also discussed her experiences with her academic advisor, noting that her advisor was not only helpful with choosing classes, but also in pointing her in the right direction regarding her career aspirations.

Not all participants had positive experiences with advising, however. Selena talked about having "trouble for a while with advising and there were some semesters that [she] didn't even

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have an advisor so [she] didn't even know what [she] was doing for a while." Mary shared

similar thoughts, expressing her frustration with the fluctuation of advising through the years,

"being tossed around, it made things not inconsistent but kind of like wonky I would say because

I didn't have that direct contact person anymore." Although students seemed to have differing

opinions about their advising situations, most were able to identify a professor or teaching

assistant whom they were able to connect and have a positive experience with.

Jason noted that most faculty whom he had encountered had made him feel included and

had "never felt, like, discriminated against." Instead, he felt like teaching assistants and

professors had "always push[ed] for [him] to succeed in class." Selena discussed that though she

had not attempted to make personal connections with any of her professors, she felt "really

comfortable in class," especially when referring to one particular professor. Bre, again,

discussed her relationships with her professors in her major, stating,

> I do feel like there are some faculty and staff that genuinely do care about me; they care
>
> about my wellbeing as a person, they care about me academically. There are faculty who
>
> will go out of their way and bend over backwards to make sure I have internship
>
> [opportunities].

Kierra also discussed her appreciation for her professors and teaching assistants. Mary listed

several faculty members by name whom she thought were very impactful to her success over her

four years at the university. She noted the "extra effort…to make sure you knew what you were

doing" as a main reason for identifying a particular professor as her favorite. Of the five faculty

and staff whom she listed as being the ones to influence her the most, she noted that they were

always inclusive and welcoming, which seemed to significantly impact her sense of belonging.

A few participants also noted that many faculty members were able to gain their trust by treating them like their peers, like any other student in the university or in their major. Despite the perceived diversity across the STEM majors, Bre discussed that her interactions with teaching and graduate assistants were "not disrespectful, it's not shady, it's not, I don't have this inferiority complex with them. They talk to me just like they talk to everyone else. They don't try to dumb things down." Mary shared a similar experience with assistants noting, "they didn't give anyone special treatment." Both participants made it clear that they did not want to feel different or feel like they were being given handouts because of their race, and that they appreciated being treated as an equal.

Two of the four cohort group participants referenced the faculty and staff within their cohort programs, attributing their feelings of inclusiveness and belonging to these individuals. Brenda talked about her experience with a program at the university, where on occasion the staff that ran the program allowed students to express frustrations they may have felt throughout the semester, including personal issues. She also discussed how her mentors made her feel "more comfortable" and made her feel "better being there." Specifically, she named two people in the program, a professor and a teaching assistant, whom she felt were two of her biggest supporters during her time at the university. She mentioned their relatability and their ability to understand her issues as a Black woman in STEM. Star also discussed her relationship with her success coach in a different living learning community at the university. Although she described a different relationship than Brenda did, Star noted that her success coach was very influential and helpful when it came to ensuring she was successful in her academics.

Table 15

Comparison of Data from PSSM Survey and Student Interviews – Theme 5: Faculty/staff interactions and support (n = 8)

Participant	PSSM Score	Exemplar quotes
Kristina	2.40	"For the most part I've actually had really nice teachers, who were really inclusive like my F.I. teacher and my stat teacher they're really like open-minded."
Kierra	2.65	"I just definitely felt like he was unapproachable, I finally talked to my professor, I can say she definitely helped me narrow down what I should take and stuff like that. I don't know. I mean, the faculty needs help."
Bre	2.70	"There are faculty who will go out of their way and bend over backwards to make sure I have internship opportunities or even if I can make it to office hours. I don't feel like I stick out so much here."
Selena	3.00	"Honestly, they're just professors to me; they're people that grade my papers. I think I had a really good biology lab TA last summer, but she wasn't a person of color, but did feel really comfortable in her class."
Jason	4.15	"I always make an effort to meet the person that teaching me, so when it comes down to it when I have like an 89.4 or something like that, they're not gonna be like "oh I don't know who that is, I'm not going to help them out." They'd say "oh look he's trying, he's working hard, he comes to my office hours, I know this guy, like he's a good guy, I'm going to help him out." And that's [sic], you feel more included because you know your teacher."
Mary	4.15	"I would say my homecoming advisor, she's from Florida. She was new my junior so she's only been here for like 2 years but even though we are still relatively close in age she was; she was like a big sister figure but also an authoritative figure that I respected. She kind of made sure I was always on my game."
Star	4.30	"I am in the [Strive] program so I have a success coach so I really feel like my success coach in the [Strive] program really helps me get to where I need to be."
Brenda	4.45	"I felt better being there and like Lauren and Dr. Hobson are really really relatable and they don't, even though they're older than us they still understand."

Theme 6 – Peer interactions and support. Peer interactions and support was discussed the most among participants. The discussion about peer-group interactions ranged from academic support that the students felt they did or did not receive, to the social experiences, both positive and negative, that were experienced with peers within students' majors and throughout the university.

The results that emerged from peer interactions and support were less surprising. The majority of the students had very positive experiences with their peers in the university and within their majors. All students across the high belonging group discussed the support that they received from their peers in regards to the academics. The majority of the low belonging group felt the same way, with one exception. The one exception, Selena, struggled to find her niche within her major; however, her experiences did not appear to be completely negative. Overall, students across the groups appeared to have very positive relationships with their peers both university-wide and major-specific.

Similar results emerged between cohort students and non-cohort students. All cohort students shared very positive experiences and perceptions regarding their peers. The majority of the non-cohort group felt the same, with one exception. The one student, as mentioned earlier, explained her lack of support from her peers in her major; it may have been beneficial for her to participate in a cohort program where she could be exposed to individuals that share the same interest, background, and goals.

Jason noted that he has "a lot of friends who [he] likes to study with" and has "found that the people that [he] stud[ies] with have become…closer friends." Kristina talked about how close she had become with her cohort from the living learning program, noting that "we all took the same classes so we all study together." Selena attributed the lack of a close group of friends

and a lack of a study group to not having many students in her major that "looked like [her]." Interactions with peers may initially appear to be mainly social; however, students' quotes indicate the possibility that close friendships could be quite impactful on their academic success.

A few students, from both spectrums of the groups, shared experiences that they perceived as negative, in regards to their peers on campus. Jason (high/non-cohort), Bre (low/non-cohort), Kristina (low/cohort), and Mary (high/non-cohort) all shared experiences that involved their peers that they felt were discriminatory. Mary shared a very specific instance in which she was made to feel uncomfortable at the university. She shared a story that occurred in her first year in the university with a White peer that lived across the hall from her in her dormitory; she overheard a conversation in which the student said: "had I known that a lot of Black people went here, I wouldn't have selected this school." A freshman at the time, Mary said, "it kind of threw me off," and made her rethink whether LUU was the right place for her. Kristina shared a similar experience. She discussed how she frequently encountered people who are surprised that she is a STEM major. During the interview, she shared a comment from a recent conversation, a classmate remarked "you don't really act like a normal Black person, like you're not like ghetto or ratchet." She was very frustrated that people often "assume that [she's] dumber because of her race." Bre also offered an experience where she did not feel welcomed at the university because of discriminatory actions of her peers. While in the courtyard of the university, a place that many students congregate during the school year, another student posted a status on a social media site saying there are "all these ugly niggers in the [courtyard]," later calling them buffoons when referring to the group of Black students. Although not all students had encountered such blatant racism, these experiences are very poignant when considering that

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the university is intended to be an arena of intellectualism, where all individuals are in pursuit of a common goal—obtaining an education.

Not all experiences shared by the students were negative, and the students who did experience such discrimination and racially charged remarks did not feel like it was frequent or the norm for the university. Bre shared that despite the lack of Black students in her major, she has been able to make close relationships with peers across the university. She explained that her group is "diverse...which makes [her] feel a little better because… [she doesn't] feel like another little Black girl walking around campus." Star attributed many of her positive peer relationships to her involvement with several student organizations. She said,

> Some people in the [program] that I'm in, I met them and I found out they're part of my major and we take some of the same classes and so now we form study groups and we go out and different things.

Kristina also shared that she was able to make most of her friends and subsequently, her study group, through her living learning community. She noted that most of her friends are "minority pre-health…doing similar things," which she believes has made her feel a greater sense of belonging since her involvement in the program. Two participants, Bre and Mary, also discussed the importance of being involved on campus with different organizations for their sense of belonging and relationship building with their peers. When asked how she would rate her sense of belonging to the university and why, Bre answered,

> There's so much more for me to do, there's so many platforms for me to be exposed to things I've never been exposed to before, definitely networking and linking up with people from other universities and people from other majors.

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Her involvement with homecoming committee, activities programming board, African Student Union, and National Association for the Advancement of Colored People (NAAC)P has allowed her to "fit in because [she] would just be isolated" if she had not been so involved. She shared that her experiences had exposed her to peers outside of her major that, without that level of involvement, she may have never met. Mary answered in a similar way when asked about the factors that influenced her sense of belonging within the university. She expressed that her involvement with homecoming planning over the last few years has allowed her to meet new people of all different backgrounds, but also shared that she wished she had been exposed to more organizations such as NAACP or Black Student Union earlier in her academic career because it "probably would [helped me feel] more of a better sense of community, [and I] probably would have been able to network with more black students that were in the STEM field."

The experiences of students in regards to their peer interactions and support differed significantly across each participant. Although this is true, none of the participant's experiences were only positive or only negative; there was a mixture of experiences among them all. It is also noteworthy to consider the impact that these interactions had on students' sense of belonging, sense of community, academics, and desire to stay at the university.

Table 16

Comparison of Data from PSSM Survey and Student Interviews – Theme 6: Peer interactions and support (n = 8)

Participant	PSSM Score	Exemplar quotes
Kristina	2.40	"…the reason I have more sense of belonging is because of my cohort, I was with them and we were all, we're all minority pre-health students."
Kierra	2.65	"The one that probably would have the biggest impact would probably be my peers… in [Advancement] so a lot of freshmen were going through the same classes to a certain point. First semester we were taking a lot of classes together so we were studying together, we were doing a lot of stuff together but second semester was kind of like a lot different, we got to do this lab report for this class and they didn't have to do that so it was a lot different second semester, I don't know what I did. I reached out to my TAs and my professors a lot more second semester.
Bre	2.70	"I don't necessarily have a lot of black people in my classes but my peer group, the people I go out with, the people I hang out with, the people I eat with, all of my friends honest to God are all black and it was not like that at my last school because it was not that many of us."
Selena	3.00	"I tend to pick and choose who I'm around, definitely. If cannot, one: be around the specific group or person, I will not be around them whatsoever. There have been times where I bypass like study times and like S.I. groups because of that…"
Jason	4.15	"…there's certain people that I found that I can be really productive…we go meet up and we can…and remind each other that we need to know this and this, and test each other, and kinda apply the knowledge that we need to know. And so I found a couple people that I can do that with and that's been really good."
Mary	4.15	"Even within the black community you have the Africans, they stick together, you have the brown people or the Indian people, they stick together, you have the white folks, they primarily stick together mainly because a lot of them are Greek too and they're in organizations, they stick together. I would say, I'm somewhere in the middle of all of that because I have some type of tie to each group whether I'm at work or whether I'm working in my organization or whether I'm just in class. I just always feel included for the most part."
Star	4.30	"It didn't take me long to make new friends. I quickly met a lot of new people, not a lot, but I quickly met new people that were like really genuinely trying to get to know me."
Brenda	4.45	"Yeah, I have friends of every, I think. I can relate to anybody, so I have friends of every race and culture but I think my closet friends are African Americans."

Theme 7 – Recommendations

The last of the themes that emerged from the data was based on the final interview question - if you could suggest something to the university administration to assist Black STEM students increase their sense of belonging, what would you suggest? This question was asked to understand more about what may be hindering their experiences in the university and in their STEM majors. Although this theme does not directly fit into either research questions that initially framed the current study, it does shed light on to what students attribute to their perceived sense of belonging and specific factors may be hindering or enhancing their belongingness. Some recommendations were shared by several participants; however, others had very unique responses to how the university could work toward increasing the sense of belonging of Black STEM students in the university.

Selena, Brenda, Star, Kristina, and Kierra provided recommendations related to their concern with the lack of Black faculty at LUU. Selena noted that more Black faculty "would help students…Black students feel more comfortable." Brenda believed that increasing the number of Black faculty would "make things easier if they understand" and students might "feel more comfortable" when approaching them. Star noted that hiring more Black faculty in STEM majors could also increase student interest in the field. Kristina also recommended that she would feel a greater sense of belonging if there were more organizations for Black students and "more celebration of [Black] culture" in the university. Kierra shared many of the same thoughts as the other students, noting that having more organizations that focus on STEM success of Black students would be beneficial to students.

Jason and Mary provided suggestions that they believed would allow students to build a strong support network in the university. When asked to make recommendations, Jason

responded by saying, "I think that maybe [LUU] should promote to people and to incoming students that [students] should make better relationships with people…branching out more and like meeting people and meeting your professors, because there are a lot of kids [that] never talk to their professors." Mary provided another very interesting recommendation on how to increase the sense of belonging and community among Black students in STEM. She suggested,

> An organization that kind of combined any Black student that's a STEM major from the beginning, it'll kinda build more of strong foundation and more of community with Black STEM majors. And you won't get the dropout or the people who kind of like switch their majors over to something else…because if you have someone going through the same thing with you, you also have that extra push, you have this brother over here, this sister over here, when you feel like you're gonna give up you won't because you have that sense of community to back you up.

This recommendation was very important to this analysis and the purpose of this study. The researcher was interested in understanding how involvement in a living learning or summer-bridge program was able to bring students together and whether it affected students' sense of belonging. This statement from this student brought to light the possible need for additional organizations that are all inclusive of these STEM students that focus on academic support and assistance and a sense of camaraderie amongst the students.

Bre presented an idea that she thought would assist students of all races, genders, and backgrounds. She expressed that she thought if there was never another Black professor hired on campus, she believed that the current professors should be mandated to take sensitivity training. She believed that diversity and sensitivity training would not only be beneficial for Black students but for students of the lesbian, gay, bisexual, transgender, queer, allies (LGBTQA)

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community and students who have disabilities. She expressed that she believed by mandating such a training, professors would learn how to relate to the issues that each of these student populations experience, saying

> You gotta watch how you talk to people. And it's not even how you talk to Black people, you gotta learn how to talk to disabled people, LGBTQA+ people, like you have to learn how to talk to people.

The data that were obtained from the qualitative phase was very rich and provided the researcher with in-depth data on how students' sense of belonging was influenced and how it was enhanced or hindered by these experiences. Without this phase of the study, the researcher would not be able to understand the nuances that are involved in Black students' experiences on the university- or program-level.

Mixed Methods Results

Research question five. The last research question - How do the experiences of Black STEM students support or contradict the results of students' perceived sense of belonging scale scores? - was included to analyze the intersection of the quantitative and qualitative findings. As discussed in Chapter Three, the researcher relied on a method called side-by-side comparison to examine how students' experiences in STEM and in the university either confirmed or disconfirmed their perceived sense of belonging as measured on the PSSM. Table 17 illustrates interpretations of the thematic analysis of the student interviews. In this side-by-side table, the researcher has provided either a positive denotation (+) or a negative denotation (-) that signify the valence, positive or negative, of each of the themes, as it pertains to each participant. Valence ratings provided throughout Table 17 are rough interpretations of the feelings expressed by the participants, and do not represent specific responses. The researcher also examined the

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subscale scores compared to the valences assigned to the participants; qualitative findings were consistent with the quantitative results and did not provide any additional information on the anomalies associated with scale scores and interviews of several of the participants. Relying on the exemplar quotes from the tables earlier in this chapter, the researcher used best judgment to interpret the valence of what each participant expressed. The researcher also took into account additional information, including quotes to extract a general meaning. The side-by-side comparison allowed the researcher to gather a more complete picture of both the qualitative and quantitative.

Table 17

Interpretation of Mixed Methods Results

Participant pseudonym (and belonging group)	Quant. belonging	Cohort	Percep. of university	Percep. of STEM	Individual attributes	Family	Faculty interactions	Peer interactions
Kristina (low belonging)	2.40	Yes	(-)	(-)	N/A	N/A	(-)	(+)
Kierra (low belonging)	2.65	Yes	(+)	(-)	N/A	(-)	(-)	(+)
Bre (low belonging)	2.70	No	(-)	(+)	(+)	N/A	(+)	(+)
Selena (low belonging)	3.00	No	(+)	(-)	(-)	N/A	(-)	(-)
Jason (high belonging)	4.15	No	(+)	(+)	(+)	(+)	(+)	(+)
Mary (high belonging)	4.15	No	(+)	(+)	(+)	(+)	(+)	(+)
Star (high belonging)	4.30	Yes	(+)	(+)	N/A	(+)	(-)	(+)
Brenda (high belonging)	4.45	Yes	(+)	(-)	(-)	(-)	(+)	(+)

(+) denotes positive valence toward the particular theme; (-) represents a negative valence toward the theme; N/A = not applicable, denotes areas in which themes were not present during interview

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Chapter V: Discussion

The number of Black students that successfully complete a degree in the STEM field has been problematic for universities across the nation (U.S. Department of Education, 2016). A number of reasons have been identified as possible causes for the lack of Black students who enter and complete STEM degrees (Maton & Hrabowski, 2004; Maton, Hrabowski, & Schmitt, 2000). Reasons vary from inability to pay for college to the lack of inclusiveness at the university and within the field. Several organizations have sought to remedy this issue by implementing activities and programs to acquaintance students to the field and help with the financial aspect of college (U.S. Department of Education, 2016).

The purpose of this study was to understand the experiences of Black students at the university and within their majors and how their sense of belonging has influenced their achievement. The current study further examined how programs, such as living learning communities, have or have not offered students resources that may have influenced students' sense of belonging. Using an explanatory sequential mixed methods research design, the current study addressed the following research questions:

R1: Quantitative: Is there a significant difference in sense of belonging between Black STEM students who participate in cohort-supported programs and those who do not participate in these programs?

R2: Quantitative: Is student self-reported GPA associated with age, gender, major, and scores on the adapted Psychological Sense of School Membership scale?

R3: Qualitative: How do Black students describe their perceptions of belongingness at the university and in their STEM programs?

R4: Qualitative: In what ways do Black students believe their sense of belonging has been enhanced or hindered while at the university and in their program?

R5: Mixed Methods: How do the experiences of Black STEM students support or contradict the results of students' perceived sense of belonging scale scores?

The Psychological Sense of School Membership (PSSM) scale was used to complete the quantitative phase of the study with 89 student participants who voluntarily took the survey. This phase was followed by semi-structured interviews with eight students that were purposefully selected based on their scores on the PSSM. The qualitative portion was used to provide clarity and further explanation on the student belonging scores. The researcher then analyzed the data using a mixed methods technique that compared the scores to quotes from the student interviews and provided information on what the students felt contributed to their sense of belonging in the university and within their programs.

The following chapter is divided into six major sections. The first three sections discuss the results of each phase of the current study; the quantitative phase, the qualitative phase, and the mixed methods phase. The implications of these results are the next section in this chapter. In the fifth section, the researcher discusses the limitations that arose within the current study and provided recommendations for potential solutions. A brief conclusion closes the chapter.

Summary of Quantitative Results

To reiterate, in the first phase of the study, an independent *t*-test and a multiple regression was performed to answer the first and second research questions. Prior to conducting these analyses, a principal component analysis (PCA) was used to determine how many components

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emerged for the PSSM scale. The researcher concluded there were two components, Interactions and Welcoming/Belonging. These two components were then used in the subsequent analysis. The quantitative phase was used to answer research questions one and two, which assisted the researcher in understanding whether belongingness could be distinguished between two groups and to determine whether it was also a factor in the academic achievement of Black STEM students. The quantitative analysis determined that sense of belonging, as measured by the PSSM, was not significant in either the independent t-test or the multiple regression. However, one demographic factor was found to be a significant predictor of academic achievement, as measured by cumulative college grade point average (GPA).

Interpretation of results. To answer the first two research questions, the researcher employed two analyses, an independent t-test and a multiple regression. The purpose of utilizing an independent t-test was to explore whether the sense of belonging subscales that emerged through the PCA showed a significant difference between those in living learning and summer-bridge programs and those who did not participate in such programs. In 2003, The National Study of Living-Learning Programs conducted a study of several living learning communities and programs across universities. In their study, researchers found significant differences in academic achievement between those who had an experienced such a program and those who had not (Inkelas & Weisman, 2003; Pascarella, Terenzini, & Blimling, 1994). Additionally, Maton, Hrabowski and Schmitt (2000) found that students in living learning communities and those who had been enrolled in summer-bridge programs were more likely to have an increase in peer interaction, faculty interaction, and significantly more positive perceptions of the university. Findings suggested that those associated with these programs were able to adjust to the college

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environment and facilitate student development better than their peers who had not been enrolled in these programs. As such, similar findings were expected for the current study.

Contrary to hypotheses, students in cohort programs did not experience significant differences in their perceived sense of belonging. The mean PSSM score on the welcoming/belonging subscale for the cohort group ($M = 3.54$) was slightly higher than the non-cohort group ($M = 3.35$) but not statistically high enough to determine that membership in a cohort played any role in students' sense of belonging. The mean scores of the the non-cohort group ($M = 3.79$) was higher than the cohort groups ($M = 3.73$), but only very slightly.

Although group differences did not emerge, the validity of the inferences obtained through the analysis may have been affected by the low sample size and the subsequent low number of students in the cohort group compared to those who had not been in a program. More than half the participants reported that they had not participated in either a living learning community or a summer-bridge program ($n = 59$). Although all programs targeted for this study met the criteria of being either a living learning community or summer-bridge program, program structures and components varied across programs. Differences across programs could have lead to nonsignificant results. Further, these findings may suggest that programs intended to increase camaraderie and to promote positive relationships may not be meeting these goals.

Although indirectly related, Zumbrunn et al. (2014) findings indicated a relationship between belonging and achievement. Strayhorn (2015) also found similar findings as the Zumbrunn team, in that sense of belonging was a significant predictor of college GPA. Strayhorn also found that high school GPA, a proxy for prior academic achievement, was a significant predictor of college GPA. The findings of the current study did not show similar results, which may have been due to the self-report of grade point average or, once again, the low

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sample size. Similar findings were expected for the current study. However, instead, age was a significant predictor of GPA, which may have been influenced by the amount of time students have been in the university. The data that were used to conduct the multiple regression met all of the required assumptions; however, here again the small sample size may have negatively affected the power associated with the analysis.

Summary of Qualitative Results

To answer research questions three and four, participants were purposively selected in the second phase of the study to participate in follow-up interviews based on their PSSM scores. From the eight interviews that were conducted, several themes emerged. There were originally 39 codes and subcodes that were then reduced to themes. Themes included: student perceptions of the university; student perceptions of STEM major; individual attributes; family; faculty/staff interactions and support; peer interactions and support; and recommendations.

Interpretation of results.

Theme 1 – Student perceptions of the university. The first qualitative theme answered research question three and included information provided by students about their perceptions of belongingness in the university. Students generally perceived their belongingness in the university to be pretty high. When asked: "If you could rate of how much you feel accepted and belong, how would you rate your experience in the university, on a scale of one to ten?" students often offered above average scores. Student ratings of their university belonging ranged from six to ten. When probed further about her rating, Star noted that there are "a lot of programs and a lot of activities for Black students and a lot of organizations." Many others reported similar reasons, which suggests that participants held generally positive views of the university. All students classified in the high belonging group had positive perceptions of the university, which

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confirmed their sense of belonging score as obtained from the PSSM scale. When examining the data of the low belonging group, the researcher found that the perceptions of these students mostly confirmed students' scores on the PSSM. Half of the students in the low belonging group seemed to have a negative perception of the university. It was unclear why there may be a difference between students in the low belonging. The students that had generally negative perceptions of the university expressed them in different ways. For instance, Kristina felt as though the university did not celebrate Black culture enough. She noted that Black organizations on campus were scarce. However, Bre shared very different ideas of the university. Although she also shared generally negative experiences in the university, her experiences were based on the "cosmetic diversity" of the university and the lack of administrator concern for the needs of Black students. Kristina's and Bre's experiences were very different, which attributed differently to their perceptions of the university.

This theme was not one that had emerged through the use of the theoretical framework or past literature. While Freeman et al. (2007) examined social acceptance in the university, there was no specific examination of students' perceptions of belongingness in the university. Zumbrunn and colleagues (2014) asked a similar question regarding students' belongingness but it pertained to the classroom-level. The current study lead to a greater emphasis on Black students' experiences university-wide.

Theme 2 – Student perceptions of STEM major. In response to research question three, students were asked: "If you could rate how much you feel accepted and a sense of belonging, on a scale of one through ten, how would you rate your experience in your STEM major?" Many students who were interviewed shared differing opinions of their perceived sense of belonging in their STEM majors. However, the consensus among all of the students was that their

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experiences in STEM were unlike the experiences that they had university-wide. For example, while Selena talked about her appreciation of the university celebrating Black culture, she also remarked that she felt like this was only the case among those in liberal studies. When asked how they would rate their belonging in STEM during the interview, many of the participants reacted by saying phrases along the lines of "that's a little different…" referring to the differing perceptions of that of the university and in STEM. Surprisingly, students who were in programs that were meant to increase their sense of community and prepare students for the STEM field did not perceive the STEM field as positively as those who had not been in a cohort program. This finding was particularly interesting because the researcher expected that the students in these programs would perceive their programs to be more inclusive and welcoming. Only one of the four students spoke highly of their experiences in their cohort program and how it influenced her success in her STEM major. The other three students agreed that the programs were helpful but did not talk about them in reference to the perception and experiences in STEM. This finding may have been surprising, but the trend that emerged between the low and high belonging group was less so. The high belonging group was more likely to talk positively about their experiences in STEM. This was expected as these students also felt a greater sense of belonging in the university as well.

Similar themes were found in Strayhorn's (2015) study – "what belongingness means to them" and "importance of belonging in STEM context." However, the theme of the current study furthers the research in the area of belongingness by not only understanding the importance of belonging but also by understanding what aspects of their experiences were the most important. The results of the current study extended the work by investigating not only Black males but Black students overall. The researcher of the current study specifically sought to

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understand how students perceived their belongingness, furthering prior literature to understanding Black students and what belongingness means to them. The current study extended this by not only examining what it meant to students but also how it was impacted or influenced.

Theme 3 – Individual attributes. Individual attributes are part of the input portion of Tinto's Model of Institutional Departure and has been found to be extremely important for student academic success (Rodgers & Summers, 2008). According to Tinto (1993), individual attributes take into account the goal commitment of students as well as their outlook on education that has been influenced by their family background. Bean and Eaton (2000, 2001) expanded on Tinto's model and included student attitude and behaviors, in conjunction with goals and intentions, which was termed, "individual psychological process[es]." The processes involved in individual attributes include self-efficacy, coping mechanisms, and locus of control.

In the current study, not all of the students discussed their individual attributes as they contributed to their sense of belonging but those who did, discussed how their personalities had contributed to and lead to a better sense of coping. Mary (high belonging, non-cohort) specifically discussed how "always seeing the bright side of things" deterred her from wanting to leave the university when faced with difficult situations, while some of her peers transferred and went to university where they believed they would feel more comfortable. These results were fairly consistent across other students in the high belonging and non-cohort groups. These students were more likely to talk positively about how their individual characteristics and attributes played a role in how they responded to situations in the university and in their STEM majors. This was expected of the high belonging group, but contrary to expectations of the non-cohort group. The researcher expected students to be more efficacious if they had a constant

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support system such as the living learning community. Living learning communities and summer-enhancement programs seek to include and assimilate students into the university and more specifically, into the STEM field. It was expected that students in the cohort group to have a more general sense of belonging and efficacy. Students in the non-cohort group may have had attributed their individual characteristics to the success because they did not have the group or cohort from the beginning as the cohort group did. Another thought about the possible differences in groups, are that students who pursue the living learning communities or enhancement programs may do so because they lack the ability, efficacious, or belongingness of the students that may not pursue such programs. Because this question was not probed, the discussion surrounding this theme occurred naturally. However, it is clear that students that discussed these attributes seemed to have more positive experiences in the university.

According to Bean and Eaton (2001), those who have a more positive response to their environment will likely have a better sense of academic and social integration. The incorporation of this theme assisted the researcher in understanding what about these students has mediated their success. Additionally, the researchers noted that these positive psychological processes also lead to "institutional loyalty" (p. 77), which was noted in the interview that was described above. Individual attributes or characteristics play an important role in determining the type of student that is entering the university and how they will react to both positive and negative experiences, which can be very telling to their willingness to persist through the university.

Theme 4 - Family. Family background was another aspect that was identified in Tinto's model as a significant mediator for goal and institutional commitment. Many participants of the current study provided information based on the support that was provided to them by their

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family members. Several participants also noted aspects related to their family background during the interview. Due to his past experiences with predominantly White institutions (PWI), Kierra discussed her father's disappointment in her that she did not attend a Historically Black College or University (HBCU). While Brenda's father, who went to LUU himself, suggested that she could do better and suggested going to a more prestigious university. The family background of these students seemed to have played a role in the decisions that these students made. Additionally, Brenda, who was urged to go to a more prestigious university remarked that she felt as though students who had parents who had completed college and had undergone similar experiences were more understanding and supportive than her parents were, noting "I couldn't go to her for help." This student was a member of the high belonging, cohort groups; she was the only student in the high belonging that spoke negatively about her experience with her parents. Students in the cohort group discussed their families about as often as those in the non-cohort group. However, students in the cohort group seemed to talk more negatively about their family's background and support than those not in a cohort. Similar to what was discussed earlier in the section on individual attributes, students that have less support may seek opportunities that provide them with a strong network. Students may have pursued such communities and programs because they did not feel equip to take on the rigor of the university or STEM field. This is only an assumption. Students in the low belonging group seldom spoke of their parents; this is an important finding and could possibly signal what may be one of the most important indicators of belongingness. In the review of literature, the researcher did not find much inclusion or discussion of family on belongingness.

Family background and support seems to be extremely important for those students who discussed it during their interviews. Research has focused fairly heavily on peer and faculty

interactions, however, parent interactions are seldom included in analysis (Freeman, Anderman, & Jensen, 2007; Strayhorn 2015). This finding does extend the researcher conducted by Fass and Tubman (2002). The researchers found that students with high parent attachment were higher functioning in the university than those with other levels of attachment. Additional studies should probe heavier on how family member interactions have had an impact on student decisions and success.

Theme 5 – Faculty/staff interactions and support. Faculty interactions was also included in Tinto's model. This factor is a part of the social system, which subsequently leads to institutional and goal commitments, or the lack of. In the current study, students were asked to talk about their interactions with faculty and staff as they related to their sense of belonging. When asked, most students spoke very highly of a select few, mainly advisors, professors, and staff members in the university. Several students contributed these close relationships to their success in the university. Mary noted that her advisor "inspired [her] a little bit more" because she was the first form of support in her department. Students in the low belonging group did not speak as highly about their faculty interactions as those in the high belonging group. This finding was not surprising because according to past research, students generally have a greater sense of belonging when there are higher levels of positive interactions.

Findings of the cohort group were unexpected. Those in this group had negative reactions of faculty interactions and support as compared to the non-cohort groups. This was unexpected because many of the living learning communities and summer enhancement programs try to ensure that students are able to build relationships with faculty in their fields. It is possible that students who have failed to build meaningful faculty relationships have not been in the university long enough to see the need or feel comfortable doing so. The analysis of this

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theme suggests how important faculty interactions are to students. Several students pointed out their desire to have relationships with faculty members but were unable to form such relationships. Students who had built strong relationships seemed to admire the commitment that faculty and staff had to students' success.

Several past studies also found that faculty interactions were important to students. In Strayhorn's (2015) study, he found that participants who had a faculty member that was close to them within their academic departments were more likely to excel in their academics and in their social environment. Similar findings emerged in Freeman, Anderman and Jensen (2007); they found that "professor pedagogical caring" was associated, although slightly, to students' sense of belonging in the university. The current study extends on this literature by providing additional information about staff members in the university. While the other studies focused on the interactions of professors, the researcher in the current study was able to gather additional information regarding staff members that were encountered on a daily basis, "Like in Starbucks…it's another day at VCU when you come in contact with them, it's cool;" regarding academic advisors, "but shout out to my academic advisor, that's my girl, she makes sure I'm on track;" and even higher level administration, "he's awesome. I contacted him a lot for things I had issues with recently for like financial stuff for school (speaking of one of the associate vice provosts)." In their interviews, participants focused on the interactions of professors as well as other people who worked in the university on all levels, which assisted in understanding the level of importance of individuals across the university to students' sense of belonging and success.

Six months prior to the commencement of this study, there were several national events going on in the news. Students across several universities began staging protests to voice their opinions and concerns regarding a range of issues including bigotry, discrimination on campus,

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and the lack of Black faculty and staff. The initial events occurred at a university in the

Midwestern United States; however, many universities from the East Coast to the West Coast

stood in solidarity with them and also staged protests based on the individual concerns at each of

the universities. The researcher believed this information was important to include because of

the nature of interviews and the frequency of students discussing the need to increase Black

faculty member presence at this particular university. The prominence of this issue for students

could be remnants of recent past experiences and events. However, this is not to say or suggest

that these students' concerns are less important or should be ignored but instead to provide

context to the study.

 Theme 6 – Peer interactions and support. Peer interactions was the most prominent

aspect of students' experiences that the participants discussed. Peer/group interactions were also

a critical factor in the social integration section of Tinto's model. Peer/group interactions were

essential for student goal commitment (Tinto, 1993) and self-efficacy of students (Bean and

Eaton, 2001).

 In the current study, there was mention of peer academic support and also social support,

which was not an uncommon finding for the area of study. Zumbrunn, McKim, Buhs and

Hawley (2014) found that peers were one of the most important sources to student

belongingness, including students with lower belonging beliefs. A similar finding emerged in

Strayhorn (2015); meaningful relationships with peers in the STEM field were found to lead to

increased belonging beliefs in the university.

 In the current study, several students mentioned that they did not have many peers in the

STEM field, which may have played a significant role in their feelings toward and perceptions of

their STEM departments. There was very little difference between how students in the low and

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high belonging groups talked about their peer interactions. The same was true for the cohort and non-cohort groups. The majority of the students (87%) in the qualitative sample spoke highly of their friend circles and felt supported by their peers. There was one student, Selena, who was in the low belonging, non-cohort groups, who did not feel as though she had established a positive social network with her peers. She expressed how she felt out of place at times and did not feel like she could work with some of her non-White peers. This student also had recently switched majors and seemed to have a more positive outlook on the possibilities in the new field. Several others noted the importance of peers; Kristina identified her peers as being the most supportive when comparing faculty, staff, and family. Most of the students were satisfied with their relationships and experiences with both their Black peers, as well as non-Black peers.

The current study helped to provide additional information that some of the previous studies had not, focusing specifically on Black students and understanding their relationship with their Black peers, as well as their non-Black peers. Without being prompted in the interview, many students brought up their interactions with their non-Black peers which ranged from appreciative of the culture to blatant discrimination. Some of these experiences were extremely troublesome to students. Bre transferred from a school because she felt uncomfortable around her peers and did not feel a sense of belonging. She also has experienced very blatant racism among her peers at LUU by being called derogatory names by peers. Jason and Selena both attested that they stopped associating with peers because of the negative interactions regarding discrimination. Mary shared a story of racial discrimination that could have caused her to leave the university. These types of experiences were very telling to how students perceived the university and their fields. All but one student could recall very specific times where they felt

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racially profiled, where they were discriminated against due to their race or gender, or just felt a general sense of not being welcome.

The stories and examples shared by the participants were very powerful. Although students encountered such negative peer interactions, they were still able to attest to the times where they felt a sense of belonging. Most of the students could not identify a specific time where they felt welcomed but could always remember the negative experiences. These experiences were the most outstanding and poignant ones. Several students expressed that they believed peer interactions was one of the primary sources of belongingness in the university. Gathering examples that were so affecting allowed the researcher to understand how the participants' really experienced and perceived their peers. This theme was able to highlight both favorable and unfavorable experiences. Gathering this information from participants was very important for the study, as peer interactions have been found to be a significant predictor of belongingness (Strayhorn, 2012; Zumbrunn et al., 2014) and academic achievement (Hausmann, Ye, Schofield, & Woods, 2009). Strayhorn (2015) briefly discussed the importance of interactions with Black peers, however, the current study suggests that interactions with peers of all races can be affecting and influencing to sense of belonging.

Theme 7 - Recommendations. To extract additional information about their thoughts about the university and their STEM major and how it could be improved for Black STEM students, participants were asked: "If you could suggest something to the university administration to assist Black STEM students increase their sense of belonging, what would you suggest?" Many students recommended additional Black faculty in the university, as a whole, but more importantly in STEM. Some students mentioned the availability of Black professors in other disciplines, but took note to the absence of Black faculty in the STEM related departments.

This was an important recommendation as faculty interaction has been found to be important to the success of students (Strayhorn, 2015). Several students mentioned the reason for the desire to have more Black faculty was due to the need to have more people who "look like me" or who can "relate to [me]."

Additional recommendations were to mandate faculty and staff diversity and sensitivity training, and to create networking opportunities through programming for Black students in STEM. Bre discussed the need for sensitivity training. She transferred from a university that frequently had racist incidents (e.g. nooses, frequent use of the word 'nigger') occur and felt that assisting people in understanding why certain actions and words are harmful could help the university become more welcoming and understanding. Mary, the student who suggested that there be a central organization for STEM students, was very involved and attributed much of her success and her high sense of belonging to networking and frequent interaction with peers.

Participants used their personal experiences to suggest recommendations that they believed would be most beneficial to the Black STEM student population. These findings extend the literature in important ways. Many similar prior studies did not probe students about their recommendations for improvement (Freeman et al., 2007; Strayhorn, 2015; Zumbrunn et al., 2014). Students are the primary constituent of the university system; why not ask them what they see as the most pertinent issues that impact their experiences and ultimately their sense of belonging?

Summary. There appeared to be several differences that emerged during the student interviews. There were some differences between students in cohorts and those categorized as non-cohort students. As expected, there were differences between the low and high belonging group. There were also differences between second-semester freshmen and upperclassmen.

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Four second-semester freshman participated in the qualitative phase of the study, and it seemed as if all of these students were apprehensive about their experiences and often remarked that they expected their experiences to change over the years. One student, Jason, explained that he believed his experiences may be different because he had not begun to take his actual STEM classes and was still taking the general education classes. Unlike their freshmen peers, the upperclassmen seemed to be much more consistent when describing their experiences at the university and within their programs. Upperclassmen participants seemed to have more definite responses to the questions throughout the interview process. The inclusion of the freshmen students could have possibly introduced some unexpected results. Although Strayhorn suggested that first-semester freshmen be excluded due to their ongoing establishment of belonging, excluding all freshmen from the study could have presented very different results. Freshmen students seemed to still be in the process of finding themselves on campus and establishing their sense of belonging.

Discussion of Mixed Methods Results

The mixing of the results from each of the phases allowed the researcher to see and understand how the follow-up phase of the study either confirmed or disconfirmed what was found in the quantitative phase. Without the second phase of the study, the researcher would be left with superficial information about the participants. As already discussed, many of the participants' interviews confirmed what was found on the survey, but there were others that had many more layers to their experiences and the sense of belonging. Analyzing the results separately was very informative, but analyzing them together provided more depth to the study. The complexities and intricacies of the study did not surface until a more critical look was taken. Initially, the differences in the belonging groups and the cohort groups were not apparent, but a

deeper dig into the data in the use of the side-by-side comparison allowed the researcher to see the small, yet possibly significant, differences.

Mixed methods results (see Table 17) suggested that the majority of students' PSSM scores were consistent with their expressed feelings, not taking into account the themes that the students did not directly discuss. This finding was true when examining the overall score on the Psychological Sense of School Membership (PSSM). When examining the subscale scores and comparing it to the qualitative portion of the study, very little new information was provided. Quantitative scores did not align with what was expressed by students during their interviews. This further provides evidence that further research should be conducted to understand the underpinnings of the belongingness and how to best measure the construct.

Additionally, the subscales that resulted from the PCA of this study were not consistent with the findings of the qualitative phase. The interactions subscale did not enhance or align with the interaction themes (i.e., family, faculty/staff interactions, and peer interactions) of the qualitative phase. These results were consistent for the welcoming/belonging subscale as well. For instance, Kristina, a member of the low belonging group, had negative feelings toward three of the four themes that she discussed during her interview. Throughout the majority of her interview, she discussed her frustrations and disappointment in the lack of Black students, lack of Black faculty, and the lack of celebration of Black culture at the university; having the lowest score on the PSSM of all participants was not shocking. Similarly, Jason, a member of the high belonging group and the only male in the qualitative phase, had generally positive feelings toward all six themes.

However, some results were surprising. Bre (low belonging, non-cohort) talked most about the negative experiences that she had at her previous university, which seemed to

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overshadow her experiences at LUU and came across as skepticism and frustration, yet she expressed positive experiences within the other themes. Bre had a low score on the quantitative portion of the study, but upon interviewing her it seemed to be more focused on the remnants of unfortunate experiences that she had experienced before coming to LUU. She even stated in the interview, "I thought it was going to be about race issue but I think I have bias just simply because where I came from," which likely played a central role in how she answered the questions on the survey. Brenda (low belonging, cohort) was another participant whose scores did not match her sentiments during the interview. She had the highest score on the PSSM out of all 89 students that took the survey, yet when talking to her she expressed some frustration, particularly with the STEM department and her family; she also had low efficacy regarding her ability to complete her degree. From the discussion with this student, she seemed to enjoy the university and had a positive perception of her belongingness at LUU but her experiences as a STEM major seemed to obstruct those original feelings. Additionally, Brenda may have felt the need to answer in a way that made her socially desirable to the researcher. Past literature, with similar studies, suggested that the scale score aligned with what students expressed during the follow-up phase of the study (Strayhorn, 2015; Zumbrunn et al., 2014). However, the same was not true for the current study. The researcher of the current study found that the perceptions of the students did not match what was expressed during the interview. Students may have a false sense of their belonging in the university and within their majors. For the most part, students' scale scores matched their expressed sentiments, but for several of the participants such as Bre and Brenda this was not true. The differences in population may play a role in how students answered the PSSM scale and the interview questions.

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Implications

The findings of the current study could provide valuable information to a number of stakeholders in education, including policy-makers, university administrators, faculty and staff, and educational researchers. Understanding the importance of belongingness and the need to belong for students in the university setting may be essential for the success of Black students in STEM and the universities they attend.

Implications for the university. The findings of this study may have significant influence on university decision-making bodies. Several groups may benefit from the findings of the study, particularly the results of the qualitative portion of the study. As one participant inquired, "do they actually…if you showed this to your committee, will they actually take this and [use this] as factors or recommendations [for] consideration [for change]?" Students have expressed the importance of sense of belonging to them and to their success in the university in STEM. Administrators in charge of policy making and programming may benefit from continued research and a continued conversation on what students believe are most important to their success.

Those in charge of planning and programming may benefit from this research. Assisting these administrators in understanding some of the concerns of the students could possibly lead to changes or increases in programming specifically targeted for Black students, and if more specifically, Black STEM students. As suggested by one of the students, universities, and essentially students, may benefit from an organization that is based in STEM that focuses on students from the time they apply, to their acceptance, and to their graduation, which allows them to be exposed to networking, building a community of like-minded peers, and receiving academic and social support from both professors, peers, and other university staff.

The results from this study also provide educators, such as professors and advisors, with information about potential factors that can have a significant role in students' development of belongingness. These personnel might use the suggestions and recommendations provided by students for prospective and incoming students as they are deciding on the university and major. Advising offices might use this information when advising students on their interests in the STEM field but may also provide valuable information into the social and personal aspects of the student's lives that may be hindering their success. As suggested by two of the participants, it may be beneficial for students to join major-specific organizations at the start of the academic career; this may be a suggestion that advisors give to students at orientation. A key aspect of the interviews was the concern for advising. Departments in charge of advising might benefit from hearing the concerns of students that lack proper advisement in a field that can be very demanding and stressful. Students were very adamant about their desire for better advising. Providing not only more advisors but advisors students can feel a connection to should be a goal of the departments in the university.

Universities also have the responsibility of providing students with the resources that are needed to be successful. Universities often believe that a number of reasons, including financial responsibility (Symonds, Schwartz, & Ferguson, 2011), may be the reason for dropout; however, it may be worth the time to understand whether students' sense of belonging may be another portion of this issue, especially within predominantly White institutions. Additionally, race climate on university campuses has been cited as reasons for leaving the university (Maton, Hrabowski, & Schmitt, 2000), which subsequently often is a part of students' perceptions of belonging and welcoming. Although negative peer interactions may not be viewed, initially, as the most important barriers to success, it seems that students are affected by it.

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Limitations and Recommendations for Future Directions

The current study has several limitations that should be addressed. The current study may have begun to contribute to the absence of literature on the belongingness of Black STEM students; however, there is still much work to be done.

Because the researcher did not feel as though the population was adequately sampled and despite continuous efforts to recruit additional students to participate in the quantitative phase of the study, only 89 participants were obtained as opposed to the target 100 students. Although the researcher was only able to sample a little less than 10% of the Black STEM population, there was a representative spread of the students, by major, who participated in the study. The researcher would like to have recruited for a longer period of time and potentially at a different point in the semester where students had not been fatigued from participating in a number of other studies. Additional studies should focus on increasing sample size to run analyses that may yield more robust results. Increasing the sample size may also provide the researcher with the ability to generalize the results across future studies. The information shared by the participants of the current study was enlightening, it would be ideal to continue this work to see what the perceptions of other students may be. Future researchers should also focus on gathering a more representative sample of males in STEM and increasing the number of students surveyed across majors. As expressed by one of the participants, the experiences across departments are very different and could be very telling of the nuances that may not be readily available by have a smaller selection of students from each major.

As well, placing a cap on the age range limited the sample size. There were a number of undergraduate students that surpassed the age cap of twenty-four years of age that may have been able to provide interesting insight into their perceptions of belongingness. Prior to

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recruitment, the researcher ensured there would be enough students in the population to obtain a sufficient sample size. Future researcher should determine whether the restricted age range of the current study was necessary. Instead of restricting the age, future researchers may include any full-time, first-degree earners in the study. Would the experiences of a student over 24 differ significantly from those of the traditional age range of 18-24? As described earlier in this chapter, there may have been differences in the way freshman and upperclassman responded to the survey and to the interview questions. These differences may have been due to the upperclassmen's experiences in the university. Although the age range may have limited the study's sample size, additional studies would benefit from being able to parse out the differences between freshmen and upperclassmen. Strayhorn (2105) suggested excluding only first-semester freshmen; the exclusion of these students could have prevented the collection of data that was distracting to other student data. However, additional information from these students could have provided richer data on this population and their belonging beliefs. Aside from the sample size of the study, the number of majors that were represented was also less than ideal. About half of majors included in this study were represented by only one or two students. As well, the researcher hoped to have a more even representation of males that had completed the survey. Only about a quarter of the surveyed students identified as male, which further lead to limitations of the qualitative phase of the study.

The sample size may have also played a role in the results that were found when conducting the principal component analysis (PCA) as well. Literature has shown that higher level analyses such as a PCA require a certain amount of participants per survey item to have the most accurate result and to be able to make the most valid inferences (Maas & Hox, 2004). A number of sources provide a variety of guidelines for sample sizes when conducting a PCA. For

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instance, Comfrey and Lee (1992) suggest that to avoid errors and to evaluate the adequacy of the sample size, researcher should adhere to the following scale: 50 – very poor; 100 – poor; 200 – fair; 300 – good; 500 – very good; 1000 or more – excellent. Additional sources have pointed to ratios that are more ideal for such procedures such as 5:1 (Hatcher, 1994) or 10:1 (Nunnally, 1978). However, Kaiser (1974), as highlighted in Fields (2013), suggest examining the KMO statistic to identify whether the analysis will yield reliable components. According to Hutcheson and Sofroniou (1999), the KMO that was obtained in the current study was acceptable (KMO = .81), which they considered as being "meritorious," or creditable (p. 225). Although the current study did not meet the guidelines that is typically required for a PCA to be conducted void of errors, additional measures suggest that the PCA should result in generalized findings and reliable components. Although this may be true, the researcher would suggest a greater sample size to ensure the inferences obtained are valid. Additionally, the researcher would suggest continuous research be conducted on the Psychological Sense of School Membership scale.

Although the scale was introduced over two decades ago, studies that have been conducted since its original development have resulted in conflicting results (Freeman, Anderman, & Jensen, 2007; Ye & Wallace, 2013; You, Ritchey, Furlong, Schochet, & Boman, 2011; Zumbrunn, et al, 2014). Several studies yielded a three-component model, while another identified a one-component as the best fit. Each of the studies that identified a three component model named each of the components differently. Ye and Wallace (2013) found that the three factors were identification and participation, fitting in with peers, and a general connection with teachers. In You et al., 2011, a three factor model also emerged, however, the factors were identified as "caring relationship, acceptance, and rejection," which was quite different from that of the other studies, including the current study. The wording of the PSSM for the current study

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may have resulted in issues with the factor loadings and the overfit of some of the items; this field of study and literature base could use additional research into the validity of the scale.

Future researcher should also focus on including other characteristics of students' experiences in their scales. The PSSM is only one scale used to measure belongingness, and although it is difficult to measure all aspects of a construct, researchers should attempt to be more encompassing of other attributes. After examining and analyzing Tinto's model and the qualitative results of this study, findings from the current study suggest that family support and background played a major role in the feeling of belongingness of students. The PSSM scale used in this study only included aspects that addressed faculty, staff, and peers. Further development of this scale, or other scales measuring belongingness, should consider including questions focusing on family and even individual attributes. The inclusion of these factors may lead to a better understanding of the construct and a clearer understanding of how sense of belonging is constructed among college students.

The sample size was also limiting to the qualitative phase. Within the students that were eligible for the qualitative study, there was only one male that fell within the high or low belongingness group, the rest of the males were considered average based on standard deviation calculations. Additionally, only one male was willing to participate in the follow-up interview; hence, there was only one male in the sample of eight for the qualitative phase. This was limiting to the study because fewer inferences could be made about the experiences of Black male students in STEM. An equal number of male and female participants would allow future researcher to obtain a broader sense of belongingness of students. The current study was limited to one male participant, which only allowed the researcher to obtain a very limited viewpoint.

Extended survey time could produce a larger sample for the quantitative phase and subsequently a larger pool to sample from for the qualitative portion of the study.

Another possible limitation of the study was the self-report measure of student achievement. Although, there is evidence to suggest that the student self-reports of GPA are often reliable and tend to be reflective of actual GPA, there may also be some form of social desirability associated with self-report (Gonyea, 2005). Participants may have felt compelled to appear more favorably or have the need to preserve their self-efficacy about their academic abilities by not answering truthfully, which may have had a negative influence on the quantitative results. However, prior to taking the survey, students were informed that their information would not be shared or disaggregated to a level that may identify them. With these cautions in place, the participants may have been answering truthfully.

The differences in the cohort-supported programs may have also been a limitation to the study. Although the surveyed programs were all living-learning communities or summer-bridge programs, each program had different components and goals, which could have lead to the lack of significance in the quantitative phase and the differing experiences expressed in the qualitative phase. Of the six programs represented by study participants, four of the programs were living learning communities and only two directly targeted minority or traditionally marginalized students. These differences could be very telling to the differences expressed by students. Future research should target specific programs intended for Black students in STEM. Appendix J includes an outline of the differences of each of the programs.

Several additional questions arose during the reflection of the results of the current study. The researcher was further interested in the perceptions of students who had already switched majors or left the university. Surveying and interviewing these students would lead to further

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information as to what may be causing students to leave or stay. A future study that includes students who are currently in STEM, as well as those that have already dropped out, could possibly answer this question. Additionally, the researcher questioned whether belongingness changes over a period of time. While interviewing the students who were freshman in the study, the researcher found that these students often were not sure of the perceptions of the university or the STEM program. They were often unsure of themselves when answering the questions and would state that they expected that their opinions on their sense of belonging and peer and faculty interactions to change over the years. The students that were graduating or close to their senior year were more situated in their experiences, which may mean that their experiences may have had a greater influence on their sense of belonging. A longitudinal study that further examines how students' perception of belongingness changes over the years would be particularly interesting to better understand the factors that have been most influential to these students and their staying power.

Conclusion

The purpose of this study was to investigate the perceived sense of belonging among Black students in STEM and its effects on several aspects of achievement. The researcher also intended to understand whether the involvement with a living learning community or summer-bridge program contributed to students' sense of belonging. Another aim of the study was to provide additional validity information on the Psychological Sense of School Membership scale that has been used in a number of other studies involving student populations. The quantitative findings of the current study suggest that being a part of a cohort program does not have any additional influence on a students' sense of belonging when comparing them to other students that have not had this same experience. Further, sense of belonging is not a predictor of student

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college GPA, as expected (Strayhorn, 2015). However, the qualitative portion provided information that was lacking in the first phase and in prior studies. The qualitative phase of the study resulted in seven distinct themes. The themes of the qualitative study were represented by the majority of the students, with exception to individual attributes and family. These themes were only discussed by a few of the participants. However, all students discussed the importance of belonging to university and within their STEM majors. The perceptions and experiences of the students were not always consistent with the students' PSSM scores, however, taking into account all of their experiences, the researcher was able to conclude that, for the most part, the interviews supported students quantitative scores. The need for follow-up was supported. The researcher found contradictory results for two of the participants after mixing the quantitative and qualitative findings. Students expressed perceptions and experiences generally supported their perceived sense of belonging as measured on the PSSM.

Given the potential power of belonging and inclusiveness in the university and successful completion of a degree, it is important to continue to expand this research. The implications of understanding the need for more cohort programs and additional efforts to increase sense of belonging of students would benefit students, universities, and policy-makers. Students who participated in the qualitative portion of the study shared in great detail the importance that they felt having a sense of belonging had on their success; one student even admitted that one of the reasons she transferred from her last university was because of the lack of belongingness. Financial issues, lack of family support, and lack of preparation for college rigor may initially seem to be leading causes of dropout of Black students, which may still be a portion of the issue; however, university officials, school counselors, and policy makers should continue to investigate the need to belong for the sake of student success. Drawing conclusions

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from past literature and interpreting what was shared during student interviews of the current study, the researcher believes that the university and university administrators should focus on several primary goals. The recommendations or goals are:

1. Enforce a mandatory culture diversity and sensitivity training for all students, faculty, and staff. Bre, who suggested this as a recommendation, believed that faculty and staff may struggle with understanding different cultures and backgrounds, which may lead to unintentional discrimination. Providing such training could assist faculty and staff, and even students, to communicate with individuals that may be dissimilar to their culture and backgrounds. This training could benefit racial minorities, women, people with disabilities, and those in the LGBTQA community.

2. Increase the number of Black faculty and staff. This has been an ongoing demand for students across the nation. Aside from professors, students have expressed how their experiences change when they are able to come in contact with individuals with whom they can identify, whether it is in advising or even financial aid. Additional Black faculty could also be helpful in increasing the number of students entering and completing their degrees. Several participants noted that it is always fulfilling to see other individuals that share their background.

3. Implement one central student group that focuses on Black STEM students. Mary, a participant of the study, suggested this and believed that having such a group would lead to a community that does not currently exist. This group could provide a push for students who may be contemplating switching majors or dropping out. At the time of this study, many universities had organizations that are specific to certain majors; however, many of the students in this study shared the need for peer groups

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that could provide a social aspect, as well as academic support. This initiative may
not need to be organized and led by the university, but promoting such an
organization could provide the sense of community many of the students failed to
have.

4. Ensure that the campus is safe and comfortable for all students. This
recommendation is one that many universities already have in place. However, after
analyzing the student interviews, it became clear that many students felt unsafe and
uncomfortable due to the discriminatory and blatantly racist comments they
experienced. Students should not feel unwanted or excluded from the university
because of their race, sexuality, or any other characteristics. If not already in place,
universities should ensure a safe space for students to express their concerns.

These goals or recommendations could potentially increase not only the belongingness of
Black STEM students, but of all students. Additionally, work still remains to be done to
understand and conceptualize what exactly sense of belonging entails and how it can be inclusive
to all races and backgrounds.

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APPENDIX A

RedCap Student Survey

Sense of Belonging of Black Students in STEM Majors

Thank you for agreeing to participate in this survey that focuses on belongingness of Black undergraduate students in STEM majors. This study is being conducted to gain a better understanding of your experiences at the university and in your major. Participating in this study is completely voluntary. The survey will take approximately **5 - 7 minutes.**

To be eligible for participation in this study, participants must meet certain requirements. If you do not meet each of the following criterion, the survey will end. Can you please answer the following questions to ensure eligibility? Thank you for your help and participation.

| Is your declared major in a STEM related field?
* must provide value | Yes |
| | No |

| Are you enrolled in the university full-time?
* must provide value | Yes |
| | No |

| Are you between the age of 18 and 24?
* must provide value | Yes |
| | No |

| Do you identify as being either Black or African-American?
* must provide value | Yes |
| | No |

| Are you at least a second-semester, freshman or higher?
* must provide value | Yes |
| | No |

The information sheet that was included in the recruitment email has been included below for your convenience and for your records.

| How old are you?
* must provide value | 18
19
20
21
22
23
24 |

| What is your major? | Short answer |

| What gender do you most identify with? | Male
Female |

| What is your estimated cumulative college GPA? | 4.0 – 3.5
3.4 – 3.0
2.9 – 2.5
2.4 – 2.0
Less than 2.0 |

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What is your academic standing?	2nd –semester freshman Sophomore Junior Senior
What is your estimated cumulative high school GPA?	4.0 – 3.5 3.4 – 3.0 2.9 – 2.5 2.4 – 2.0 Less than 2.0
Have you been or are you currently involved in a cohort program (e.g. living learning community, summer-bridge program)?	Yes No
Which program?*	Short answer
How long?*	Less than one year One year Two years More than two years
Would you be willing to participate in a brief, follow-up interview?	Yes No
Please provide a phone number or email address where you can be reached.*	Short answer

Sense of Belonging Survey

Instructions: Please rate the following statements on how true they are to you based on your experiences in the university.

1. I feel like a part of the university.	Not at all true Slightly true Somewhat true Very true Extremely true
2. Sometimes I feel as if I don't belong at this university. [R]	Not at all true Slightly true Somewhat true Very true Extremely true
3. As a student, there are a lot of activities that I can participate in at the university.	Not at all true Slightly true Somewhat true Very true Extremely true
4. I can really be myself at this university.	Not at all true Slightly true Somewhat true Very true Extremely true
5. I wish I were at a different university. [R]	Not at all true Slightly true Somewhat true Very true

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6. I feel proud of belonging to this university.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

7. There's at least one professor at this university that I can talk to if I have a problem.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

8. People at this university are friendly to me.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

9. Professors here are not interested in people like me. [R]

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

10. In the university, I am treated with as much respect as my peers.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

Instructions: Please rate the following statements on how true they are to you based on your experiences in your STEM Major.

11. People in my program notice when I'm good at something.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

12. It is hard for people like me to be socially accepted in my program. [R]

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

13. Other students in my program take my opinions seriously.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

14. Most professors in my program are interested in my work.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

15. I feel very different from most other students in

Not at all true
Slightly true

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my program. [R]

Somewhat true
Very true
Extremely true

16. The faculty and staff in my program respect me.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

17. People in my program know I can do good work.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

18. Other students in my program like me the way I am.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

19. There are other students in my program that I feel comfortable talking to if I have a problem.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

20. I feel included when completing group work.

Not at all true
Slightly true
Somewhat true
Very true
Extremely true

Thank you for your time and willingness to participate in my survey to help with my dissertation research. If you have any additional questions, I can be contacted at jacksonl3@vcu.edu. **Have a great day!**

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Interview Protocol

Tell me a little about yourself.

Describe your experiences in the university as a Black student.

Probe: Has it been good or bad?

Describe your experiences as a Black STEM student in your program.

Probe: Has it been good or bad?

If you could rate how much you feel accepted and a sense of belonging, on a scale of one through ten, how would you rate your experience in your STEM major

Probe: As a STEM major?

Tell me about a time when you did not feel accepted or included in your program or in the university.

Probe: Why did you not feel included?

Tell me about a time when you felt like you were a part of the campus community.

Probe: Why did you not feel included?

What support systems were in place that influenced your sense of belonging?

Probe: Describe your experiences with the faculty and staff in your program.

Probe: Describe your experiences with peers on campus and in your program.

Probe: Describe how your family has influenced this.

If you could suggest something to the university administration to assist Black STEM students increase their sense of belonging, what would you suggest?

Recruitment Email

Dear Students,

My name is Lisa Jackson and I am doctoral student at Virginia Commonwealth University pursuing a degree in Educational Psychology. I am contacting you in hopes that you will participate in a study for my dissertation research that I am conducting focusing on sense of belongingness of Black students with STEM majors.

The purpose of this study is to understand the experiences of students at the university and program, and their sense of belonging has influenced their academic achievement. Sense of belonging in higher education has been defined as the connection that an individual feel to their university, their peers, and their professors. This construct has been found to have several positive benefits, and I would like to see if this is true of students on the university-level.

The study consists of two parts. The first part will be a short survey that will take approximately 5-10 minutes. The second part will include an interview that will take approximately 30 minutes. If you participate in the survey, you do not have to participate in the interviews. Students that choose to participate in the follow-up interviews will be contacted in a separate email. To be eligible for this study you must meet the following criteria:

(a) have declared of an academic major in a STEM related field
(b) enrolled in the university as a full-time student
(c) be between the age of 18 and 24; and
(d) identify as Black or African-American.
(e) be a second-semester, freshman or higher

If you agree to participate, an information sheet has been provided for your records. Click here to access the link to the survey [add link].

If you have any questions or concerns I can be contacted by email at jacksonl3@vcu.edu.

Thank you for your time,

Lisa Jackson
Doctoral Student
Foundations Department – Educational Psychology
Virginia Commonwealth University

APPENDIX D

Survey Reminder Email

Good [time of day] Students,

My name is Lisa Jackson and I am doctoral student at Virginia Commonwealth University pursuing a degree in Educational Psychology. I am contacting you again in hopes that you will complete the survey that I sent out a few weeks back regarding Black students with STEM majors sense of belonging. This is just a reminder that if you have not taken the survey yet, it would be greatly appreciated if you did. This work is being completed for my dissertation research. The survey will be closed on [add date].

The purpose of this study is to understand the experiences of students at the university and program, and their sense of belonging has influenced their academic achievement. The survey will only take 5-10 minutes.

If you agree to participate, an information sheet has been provided for your records. Click here to access the link to the survey [add link].

If you have any questions or concerns I can be contacted by email at jacksonl3@vcu.edu.

Thank you for your time,

Lisa Jackson
Doctoral Student
Foundations Department – Educational Psychology
Virginia Commonwealth University

APPENDIX E

Information Sheet – Survey

Belongingness of Black Undergraduate in STEM Majors

Thank you for agreeing to participate in this survey that focuses on belongingness of Black undergraduate students in STEM majors. This study is being conducted to gain a better understanding of your experiences at the university and in your program. The survey will ask questions about your sense of belonging at the university- and program-level.

Participating in this study is completely voluntary and you are able to participate as little or as much as you wish. You are free to skip questions, as well. You can discontinue participation in this study at any point without consequence and without giving the researcher notice. Precautions will be taken to keep your identity confidential. Information that may identify you will not be collected. Additional information may be asked of you (i.e. email address) but you are able to skip this question if you do not wish to be contacted.

If there are any questions or concerns at any point during the study you are able to contact the primary investigator, Lisa Jackson at jacksonl3@vcu.edu.

If you have questions about your rights as a subject/participant in this research study, or if you feel you have been placed at risk, you can contact:
Office of Research
Virginia Commonwealth University
800 East Leigh Street, Suite 3000
P.O. Box 980568
Richmond, VA 23298
Telephone: 804-827-2157

Thank you,

Lisa Jackson, M.A.
Doctoral Student
Foundations Department - Educational Psychology
Virginia Commonwealth University

APPENDIX F

Information Sheet – Interview Follow-up

Collective Efficacy and Belongingness of Undergraduate Students

Thank you for agreeing to participate in the interview that will discuss your experiences at the university and in your program, and how they have related to your sense of belonging. This portion of the study is being conducted to gain a better understanding of your answers from the survey you completed.

Participating in this study is completely voluntary and you are able to participate as little or as much as you wish. You are free to not answer questions. You can discontinue participation in this study at any point without consequence and without giving the researcher notice. If you wish to withdraw your participation any data that was collected will be destroyed. Precautions will be taken to keep your identity confidential, you may choose to a pseudonym to go by or a random number will be assigned to you.

The interview will be audiotaped and transcribed by the investigator. The audiotaped data will be stored in a locked location, which only the primary investigator will have access. The audiotapes and transcriptions will be destroyed once the study has been completed.

If there are any questions or concerns at any point during the study you are able to contact the primary investigator, Lisa Jackson at jacksonl3@vcu.edu.

If you have questions about your rights as a subject/participant in this research study, or if you feel you have been placed at risk, you can contact:
Office of Research
Virginia Commonwealth University
800 East Leigh Street, Suite 3000
P.O. Box 980568
Richmond, VA 23298
Telephone: 804-827-2157

Thank you,

Lisa Jackson, M.A.
Doctoral Student
Foundations Department - Educational Psychology
Virginia Commonwealth University

Interview Reminder Email

Good [time of day] students,

My name is Lisa Jackson and I am doctoral student at Virginia Commonwealth University pursuing a degree in Educational Psychology. I would like to thank you for taking time out to complete the survey on sense of belonging of Black STEM students and to remind you of the interviews that will be taking place as follow-up to the survey that you completed. At the end of the survey, you volunteered to participate in a follow-up interview to discuss your experiences at the university and in your program.

The purpose of this study is to understand the experiences of students at the university and program, and their sense of belonging has influenced their academic achievement. The interviews will take 30-45 minutes. If you still would like to participate, please contact me at jacksonl3@vcu.edu.

If you have any questions or concerns I can be contacted by email at jacksonl3@vcu.edu.

Thank you for your time,

Lisa Jackson
Doctoral Student
Foundations Department – Educational Psychology
Virginia Commonwealth University

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Appendix H

Professor, Program Director, Organization Leader Email

Good [time of day],

My name is Lisa Jackson and I am a doctoral candidate in the School of Education. I am completing my dissertation research on sense of belonging of Black students in STEM majors. I am contacting you to ask for your assistance in recruiting students for my study. My target population is students in their first-year, second semester and up that identify as Black and have a declared major in a STEM field.

Belongingness has been associated with a number of positive outcomes including persistence in college, increased academic achievement, and increased self-efficacy. In my study, I would like to understand whether Black students' sense of belonging is associated with their college grade point average and to further understand how their experiences here at VCU and in their STEM major has influenced their sense of belonging.

The study includes a survey that will take approximately 10 minutes and follow-up interviews. Students will only be considered for follow-up interviews if they select to during the survey. I appreciate any help that you are able to offer. I am also able to send the student recruitment email to you, which includes the survey link for students.

Thank you for your time and consideration,

Lisa Jackson

Doctoral Candidate

School of Education – Educational Psychology

Virginia Commonwealth University

APPENDIX I

Member Checking Email

Hello,

I'd like to thank you again for being willing to participate in my study. Your input was very helpful. As I told you during the interview, I am attaching the transcript from your interview. If you wish to change, add, or remove anything, I ask that you have it back to me by [7-day time cap]. If you do not have any changes, you can tell me that too. If I do not hear from you by the [7-day time cap], I will assume that you are okay with what is in the transcript.

Once again thank you for your time! I hope your semester wrapped up nicely and I wish you the best of luck in your program.

Best,

Lisa Jackson

Survey Cohort Program Descriptions

Program Name*	Components	Target Students	University specific/nationwide?	Goal
Advancement	Summer session Living learning community	Freshman interested in pre-health concentrations	University specific	Provide exposure to health professions
Edge	Living learning community	Students focused on professional leadership	University specific	Prepare students who can successfully lead professional organizations
LSAMP	Summer-bridge	Underrepresented students in STEM	National program (held at several universities)	Increase the success and quantity of underrepresented students who successfully completing STEM degree programs, and to increase the number of students qualified for and matriculating into STEM graduate programs
Orb	Living learning community	Students interested in globalization	University specific	Expand knowledge and impact of globalization and enhance leadership skills in global education
Pre-College Program	Summer-bridge	Underrepresented groups in STEM	National program (all students can apply)	Provides students from underrepresented backgrounds with the foundation of engineering through problem solving
Strive	Living learning community	Students interested in community engagement	University specific	Enrich students' understanding of how to create positive change in communities

*Each program was assigned a pseudonym to maintain confidentiality